DICTIONARY OF MEDICINE

R. QUAIN, M.D.

A

DICTIONARY OF MEDICINE

INCLUDING GENERAL PATHOLOGY, GENERAL THERAPEUTICS
HYGIENE AND THE DISEASES OF WOMEN AND CHILDREN

BY VARIOUS WRITERS

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LIST OF ILLUSTRATIONS

IN VOLUME II

FIGURE		PAGE
68.	Finkler's Spirillum and Koch's Cholera Spirillum	78
69.	Spirillum undula, showing various forms and stages and variety in number of the flagella	78
70.	Typhoid Bacilli	79
71.	Cladothrix dichotoma	79
72.	Stages in the Growth of a Bacillus, and of Spore-formation	80
73.	Different forms of Micrococci	80
74.	Sarcina ventriculi, showing sarcinæ and starch granules in vomited matter	81
75.	Masses of Micrococci in the vessels in 'Surgical' Kidney	88
76.	Streptococci in Fœtid Sputum	89
77.	Streptococci of Suppuration	89
78.	Multiple Suppurative Septic Nephritis ('Surgical' Kidney)	89
79.	Micrococci in Capillaries of Kidney in Multiple Septic Abscess	91
80.	Micrococci of Gonorrhœa	94
81.	Acute Pneumonia; dried sputa showing *Streptococcus lanceolatus*, &c.	96
82.	Tetanus Bacilli	98
83.	Tubercle Bacilli from lung, sputum, and intestines	101
84.	Tubercle Bacilli in section of a cow's udder	102
85.	Leprosy; section of skin showing superficial and deep parts	105
86.	Koch's 'Comma Bacillus,' or Spirillum of Asiatic cholera	109
87.	Finkler's Spirillum and Koch's Cholera Spirillum	110
88.	Bacilli and Leucocytes in the spleen in Anthrax	114
89.	*Bacillus anthracis* in a blood-vessel in the heart of a cow	114
90.	Streptococci and Bacilli in false membrane from a case of Diphtheria	117
91.	Typhoid Bacilli in section of a swollen Peyer's patch	121
92.	Typhoid Bacilli: section showing cilia	121
93.	Red Blood-corpuscles—human . *to face*	135
94.	Leucocytes—pus, mucous or white blood-corpuscles „	135
95.	Epithelial Cells „	135
96.	Spermatozoa „	135
97.	Hooklets of Echinococcus „	135
98.	Hæmatoidin, Hæmin, and Charcot-Leyden Crystals „	135
99.	Milk and Colostrum Corpuscles „	135
100.	Microscopical characters of objects seen in Vomited Matter „	135
101.	Microscopical characters of objects seen in Sputum „	135
102.	Microscopical characters of adventitious objects „	135
103.	Tyrosin „	135
104.	Triple or Ammonio-magnesium Phosphate „	135
105.	Cholesterin „	135
106.	Chloride of Sodium „	135
107.	Oxalate of Calcium; dumb-bells and octahedra „	135

FIGURE		PAGE
108.	Microscopical character of Cystin *to face*	135
109.	Microscopical character of Uric Acid; various forms . . „	135
110.	*Oïdium albicans*, or *Saccharomyces mycoderma*	165
111.	Small-pox—chart showing mortality (1841-1890)	346
112.	Whooping-cough—chart showing mortality (1841-1890) . . .	346
113.	Measles—chart showing mortality (1841-1890)	346
114.	Scarlet Fever—chart showing mortality (1861-1890)	346
115.	Diphtheria—chart showing mortality (1861-1890)	347
116.	Enteric Fever—chart showing mortality (1869-1890)	347
117.	Giant-cell enclosing the clubs of the Fungus in Actinomycosis . .	384
118.	Phagocyte of the Daphnia, containing two undegenerated spores of the Monospora	384
119.	Spore of the Monospora enclosed by phagocytes, and undergoing degeneration	384
120.	Lymphocyte; Mononuclear Leucocyte	385
121.	Eosinophile Leucocyte; Polynuclear Leucocyte	385
122.	Psorosperms from a Ureter . .	548
123.	Pulse-trace, typical	580
124.	Pulse-trace, of high tension . .	580
125.	Pulse-trace, of low tension . .	580
126.	Pulse-trace, hard variety, of peritonitis, enteritis, aud pericarditis . .	583
127.	Pulse-trace, hard variety, of contracted kidney	583
128.	Pulse-trace, hard variety, of cardiac hypertrophy and degeneration of blood-vessels	583
129.	Pulse-trace, hard variety, of aortic insufficiency	583
130.	Pulse-trace, soft variety, of pyrexia, and dicrotous	583
131.	Pulse-trace, soft variety, of rheumatic fever	583
132.	Pulse-trace, soft variety, of debility .	583
133.	Pulse-tracc, soft variety, of collapse in fever	584
134.	The Spleen in Anthrax . . .	592
135.	Authrax Bacilli, various forms . .	596
136.	Bacilli from the fluid exuded from the Lung in a case of internal Anthrax	596
137.	Sarcina ventriculi, showing sarcinæ and starch-granules in vomited matter	709
138.	Spectra of pigments . . *to face*	783
139.	Sphygmographic tracing, showing obstructed peripheral circulation .	790
140.	Sphygmographic tracing, showing easy and quick capillary circulation .	790
141.	Sphygmographic tracing, showing hyperdicrotism	790
142.	Sphygmographic tracing, showing contractiou of muscular coat of artery .	791
143.	Sphygmographic tracing, showing rigidity of arterial walls . . .	791
144.	Sphygmographic tracing, of right radial artery in anenrysm of the aorta	791
145.	Sphygmographic tracing of left radial artery in aneurysm of the aorta .	791
146.	Sphygmographic tracing in aortic regurgitation	791
147.	Sphygmographic tracing in aortic stenosis	792
148.	Sphygmographic tracing in mitral regurgitation	792
149.	Sphygmographic tracing in mitral stenosis	792
150.	Spinal Cord, sections from three situations in normal state . .	795
151.	Spinal Cord, sections showing lower cervical, mid-dorsal, and mid-lumbar regions	797
152.	Spinal Cord, sections showing 'Descending Cerebcllar Tract' . .	799
153.	Spinal Cord, sections showing descending areas of degeneration .	804
154.	Spinal Cord, section showing ascending areas of degeneration . .	804
155.	Spiual Cord, scctions showing peculiar areas of ascending degeneration .	804

FIGURE		PAGE
156. Spinal Cord, sections showing part of a healthy lateral column and patch of secondary degeneration in lateral column		805
157. Sections showing probable skin-fields from the second lumbar to the first sacral segments		810
158. Tubercle Bacilli in Sputum		872
159. Elastic Tissue of the Lung in Sputum		874
160. Fibroma (Neuroma)	*to face*	1085
161. Polypus of Nose	,,	1085
162. Myxoma	,,	1085
163. Ossifying Chondroma	,,	1085
164. Enchondroma (of Jaw)	,,	1085
165. Enchondroma (of Orbit)	,,	1085
166. Myeloid of Jaw	,,	1085
167. Large Round-celled Sarcoma	*to face*	1085
168. Small Round-celled Sarcoma	,,	1085
169. Oval-celled Sarcoma	,,	1085
170. Lymphoma	,,	1085
171. Small Spindle-celled Sarcoma	,,	1085
172. Alveolar Sarcoma	,,	1085
173. Mixed Sarcoma	,,	1085
174. Melanotic Sarcoma	,,	1085
175. Large Spindle-celled Sarcoma	,,	1085
176. Urinary Flocculi		1137
177. Vaginal Speculum—Cusco's bivalve		1224
178. Vaginal Speculum—Fergusson's		1224
179. Vaginal Speculum—The Duck-bill		1224
180. Uterine Sound		1225
181. Uterine Probes		1229

DICTIONARY

OF

MEDICINE

M

MACROCHEILIA (μακρός, great; and χεῖλος, the lip).—A condition, usually congenital, in which the lips are hypertrophied.

MACROCYTE (μακρός, great; and κύτος, a hollow).—A form of large red blood-corpuscles met with in some kinds of anæmia. *See* ANÆMIA, PERNICIOUS.

MACRODACTYLIA (μακρός, great; and δάκτυλος, a finger).—Hypertrophy of one or more fingers, either congenital or developing in childhood.

MACROGLOSSIA (μακρός, great; and γλῶσσα, the tongue).—Fr. *Macroglossie*; Ger. *Zungenvorfall.*

The term 'macroglossia' is applied to an enlargement of the tongue, which sometimes goes to the extent of protrusion of the organ from the mouth. This affection seems to depend on dilatation of the lymphatics, with lymphstasis, leading to hyperplasia of the connective and lymphoid tissues. It is sometimes associated with idiocy or imbecility. The cause of the lymphangiectasis, which is probably the fundamental condition, is undecided. *See also* TONGUE, Diseases of.

MACROSOMATIA (μακρός, great; and σῶμα, the body).—Fr. *Macrosomatie*; Ger. *Riesenwuchs.*—A condition in which the whole body becomes enlarged in a monstrous degree. *See* HYPERTROPHY.

MACROSTOMIA (μακρός, great; and στόμα, the mouth).—A congenital enlargement of the mouth, due to imperfect closure of the mandibular fissure upon one or both sides. It is a rare deformity, and is generally accompanied by malformation of the auricle, by an accessory tragus, or by a mandibular tubercle. Excessive closure of the mandibular fissures may also occur, leading to *microstoma.*

MACULÆ (*macula*, a spot or stain).—SYNON.: Fr. *Macules*; Ger. *Flecke.*

Willan's definition of macula is 'a permanent discoloration of some portion of the skin;' and that author adopted the term as the title of his eighth order of cutaneous affections, including sunburn, nævus, and spilus. The term 'maculæ' is likewise applied to a hyperæmic state of the skin, which may be simply chronic without being permanent, such as those which have received the name of *maculæ syphiliticæ.* Maculæ, therefore, may be merely pigmentary, and located in the rete mucosum alone; or they may be hæmorrhagic, and seated in the derma and subcutaneous tissues. Sunburn, freckles, liver-spot, bronzed and melasmic spots, and the stains left on the skin after the dispersion of certain cutaneous eruptions, such as psoriasis, acne, lichen planus, syphilis, and leprosy, are examples of pigmentary maculæ; whilst leucodermic spots and blotches represent an absence of pigment. The maculæ resulting from a permanent hyperæmia of the blood-vessels of the skin, such as flat vascular nævi and the claret-stain nævus, disappear under pressure; whilst the hæmorrhagic maculæ are represented by the escape of the red corpuscles of the blood from the vessels, and their diffusion in the connective tissues, such as occurs in purpura and in bruises.

ERASMUS WILSON.

MADEIRA, North Atlantic Ocean. Moist, mild, equable climate; absence of dust; well protected. Mean temperature 61° F. *See* CLIMATE, Treatment of Disease by.

MADNESS.—*See* INSANITY.

MADURA-FOOT.—A synonym for fungus-foot of India. *See* FUNGUS-DISEASE OF INDIA; and ACTINOMYCOSIS.

MAGGOTS.—A popular term for the parasitic larvæ of various insects, including bots. *See* ŒSTRUS; and NOSE, Diseases of.

MAGNETISM, ANIMAL. — This name was formerly applied to the imaginary new force or principle, supposed to be akin to magnetism, and to be in operation when individuals were 'mesmerised.' This hypo-

thetical new force was thought to be called into play by the mesmeriser; and it was deemed to be by virtue of its influence that the will, thoughts. and actions of the 'medium,' or person mesmerised, are capable of being modified in the so-called mesmeric trance or sleep. This view as to the nature of the causal conditions is now regarded as altogether erroneous and devoid of all foundation in fact, although certain remarkable effects may unquestionably be produced on many persons (by so-called 'mesmeric passes,' by concentration of attention associated with some strain of ocular muscles, by attention to a series of weak monotonous sensations, or other related means), owing to the induction in such persons, under physiological conditions, of some at present imperfectly understood state or modification of cerebral activity (*see* MESMERISM). This state is now generally spoken of as the 'hypnotic condition,' 'hypnotic sleep,' or 'hypnotism'; or more rarely as 'induced somnambulism.' On the other hand, when such a state is induced, as a therapeutic means or agency, it has been spoken of as 'Braidism' (*see* BRAIDISM). The latter appellation has been given in honour of the Manchester surgeon, James Braid, who first showed in an unmistakable manner that all the real phenomena displayed by mesmerised persons were not due to any new force or principle, akin to magnetism, which had been made to operate in or upon them, but were attributable to the fact that certain altered functional states of the brain had been self-induced by the individual under the influence of one or other of the exciting conditions already mentioned. In these altered brain-states the functional activity of certain parts of the cerebrum is annulled, whilst that of others is often remarkably exalted. The freedom with which such altered brain-states may be induced varies greatly in different persons; and the states themselves also vary much in their degree of intensity in different individuals, or in the same individual at different times. This latter side of the question has been greatly elucidated by Charcot and others during recent years. Charcot, in fact, regards what is known as the 'hypnotic state' as variously composed (on different occasions) by phenomena pertaining to one or more of the three simpler conditions, known as (1) 'induced somnambulism,' (2) catalepsy, and (3) lethargy. Nothing is more remarkable in connexion with this subject than the rapidity with which persons may be made to pass from one to the other of these stages, and the simplicity of the means by which such changes of state may be effected. Important side-lights have, moreover, been thrown upon the relations and genetic conditions of such causally obscure neuroses as somnambulism and catalepsy. *See* MESMERISM.

H. CHARLTON BASTIAN.

MALACOSIS (μαλακός, soft).—A term for the morbid softening of structures. *See* SOFTENING.

MALACOSTEON (μαλακός, soft; and ὀστέον, a bone).—A peculiar disease of bone, characterised by softening. *See* MOLLITIES OSSIUM.

MALAGA, in South of Spain.—Dry, mild, bracing, equable climate. Mean temperature in winter, 55° F. Winds: N.W. (*Terral*), dry and dusty; E. (*Levante*), cold and damp. Drawbacks: bad drainage and cookery. *See* CLIMATE, Treatment of Disease by.

MALAISE (Fr.)—SYNON.: Indisposition; Ger. *Missbefinden.*—In cases of simple digestive derangement, in ague, and in the stage of invasion of many acute diseases, the patient very commonly first becomes aware that his health is disturbed by a feeling of general illness, which is known as malaise.

DESCRIPTION.—Under the circumstances just mentioned, the ordinarily unconscious feeling of being well, or *bien-être*, which accompanies perfect health, is replaced by a painful and depressing feeling, which the patient probably cannot describe otherwise than as a sense of being weak, languid, listless, and disinclined to bodily or mental exertion. Malaise is commonly associated with bodily debility, chilliness, or actual rigors, moderate pyrexia, general pains or aches, giddiness, headache, and anorexia. In the course of the more serious diseases in which it occurs, malaise either passes off or soon gives place to more urgent symptoms—such as depression, apathy, delirium, or stupor; but in other instances it persists, and constitutes the chief subjective phenomenon of the disease, as in some cases of typhoid fever.

TREATMENT.—The treatment of malaise will depend upon the nature of the cause of the feelings just described, and should be directed to its removal or remedy.

J. MITCHELL BRUCE.

MALARIA (Ital.)—SYNON.: Marsh Miasm; Fr. *Mauvais Air*; *Intoxication des Marais*; *Intoxication Tellurique*; Ger. *Malaria.*

DEFINITION.—An earth-born poison, generated in soils the energies of which are not expended in the growth and sustenance of healthy cultivated vegetation. By almost universal consent this poison is the cause of all the types of intermittent and remittent fevers, commonly called *malarial*, and of the degeneration of the blood and tissues resulting from long residence in places where this poison is generated.

The Italian word *malaria* is now employed to convey the meaning expressed in the above definition. It is certainly preferable to the

term *marsh miasm*, which implies that marshes are the sole source of the poison. M. Léon Colin, Professor of Military Medicine in the Val-de-Grace, who has written an instructive work on malarial fevers, does not use the term 'malaria' to distinguish the agent that causes them; he prefers the term 'telluric poison,' *intoxication tellurique*, proceeding from the energy of the soil, when that energy is not absorbed by its natural consumers, crops or plants—in a word, healthy cultivated vegetation.

Essential Nature.—What is this fever-generating agent to which the term 'malaria' has so long been applied? The writer, in the first issue of this Dictionary, while unable to assent to the so-called *Bacillus malariæ* of Tommasi-Crudeli and Klebs, as the cause of malarial fevers, did not withhold what they had written on the subject. This supposed bacillus is now on all hands allowed to be non-existent, and will never more be heard of. The theory now in fashion is based on the observations of Marchiafava and Celli, on the blood of malarial patients in the Santo Spirito Hospital in Rome; of Laveran, in Algiers; Osler, of the Johns Hopkins Hospital, Baltimore; and Dr. Vandyke Carter, principal of Grant College, Bombay. They describe a parasite, possessing amœboid movements, which is found in the red corpuscles, and have named it 'Plasmodium malariæ,' or, according to Laveran, *Microbe du paludisme*; they believe that it only occurs in cases of malarial fever, and consider the parasite to be one of the Mycetozoa. It is readily stained with methylene blue. Marchiafava and Celli maintain that it appears at the onset of the fever, becomes more numerous as the fever increases, and disappears with the fever. *See* Micro-organisms.

The occurrence of anæmia in the course of malarial fevers is an old and familiar fact; and the rapidity with which this sometimes occurs is remarkable (*see* Intermittent Fever). The authors of the theory under notice explain the phenomenon by the action of the microbe on the red corpuscles, on which it preys, leaving nothing in their place but the dark pigment so commonly seen in the organs of malarial subjects. Dr. Vandyke Carter announces a discovery which, if confirmed by other observers, is of great interest. He further describes leucocytes in the blood in ague, the *raison d'être* of which is to prey upon the *microbe du paludisme*. The question is, assuming the entire accuracy of the observations given above in outline, does the existence of this parasite explain the cause of malarial fevers? The authors of the theory maintain that it does. They did the same in the case of the mythical bacillus malariæ. This is, in the judgment of the writer, a verdict not supported by the facts. This plasmodium malariæ has never been seen outside the body, and there is no evidence that it has ever been artificially cultivated. It is inconceivable that such an organism can exist and propagate in the great variety of soils and climatic conditions where malarial fevers are found.

Genetic Relations.—When we consider that in many regions of the globe two-thirds of the mortality is caused by the fevers, and their sequels, to which this poison gives rise, we can understand why all that relates to malaria is important to the statesman, the soldier, the sanitarian, and the physician. 'Fevers,' says Dr. Cornish, the Sanitary Commissioner of Madras, 'one year with another destroy twice as many people in India as small-pox, cholera, and all other epidemic causes put together.' The late Dr. Parkes has well said 'that when a climate is called "unhealthy," it is simply meant that it is malarious.' This remark is especially true of tropical climates. Malaria has generally been said to be the product of heat, moisture, and vegetable decomposition. The terms *marsh miasm* and *paludal fevers*, long employed to distinguish the poison and the fevers to which it gives rise, mark the almost universal belief that the air of marshes alone is endowed with the power of generating them. That low, moist, and warm localities are generally noted as malarious is indisputable. Marshes are not, as a rule, dangerous when abundantly covered with water; it is when the water level is lowered, and the saturated soil is exposed to the drying influence of a high temperature and the direct rays of the sun, that this poison is evolved in abundance. The production of malaria on a great scale in this way was seen in the district of Burdwan, in Bengal. The soil is alluvial, but dry; and, until within the last few years, Burdwan was more salubrious than the central or eastern districts of the Lower Gangetic delta. The drainage of the district became obstructed by the silting up of its natural and artificial outlets, and the result was a waterlogged condition of the soil, the development of malaria, and an alarming increase in the death-rate.

Malaria is, however, generated under conditions apparently widely different from the above. When the British army under Wellington was operating in Estremadura, the country was so arid and dry for want of rain that the rivers and small streams were reduced to mere lines of widely detached pools; yet it was assailed by a remittent fever of such destructive malignity 'that,' says Ferguson, who records the fact, 'the enemy and all Europe believed that the British host was extirpated.' A fever of like malignity scourged the same army in the bare open country by which Ciudad Rodrigo is approached from the side of Portugal, at a time when, says the same author, 'the vegetation was so burned up that the whole country resembled a brick-ground.' It must,

however, be kept in mind that both districts are in the rainy season flooded with water, at which time they are healthy, until the drying process begins under the action of a powerful sun.

Malaria is notoriously rife in soils, the upper strata of which are rich in organic matter, and are from any cause left to nature uncultivated, and to the influence of the sun. The Roman Campagna is a well-known example of this kind. M. Léon Colin has explored this tract of country in search of the commonly recognised sources of malaria, and reports it everywhere dry and free from stagnant water. But the cultivating hand of man has long been withdrawn from this once fertile region, and the energies of its rich soil, instead of being directed to food-producing ends, are wholly given up to the development of malaria, for which it is notorious.

It is well known that so-called malarial fevers prevail in some of the most sterile regions of the earth. Here, it is often said, 'there is no organic matter, no vegetative energy running waste, on which to fall back for an explanation.' Yet many of those desert places, to all appearance under the curse of perpetual barrenness, do contain organic matter, and are in reality so full of vegetative energy, that water only is wanted to fit them for the productive labour of the husbandman. There are millions of acres in India, now supplying abundant harvests, which, if water was withdrawn, and the cultivating hand of man withheld, would quickly relapse into deserts fruitful only in malaria.

We need not go to tropical countries in search of examples of this kind: our own country can furnish them in abundance. So late as the reign of the sister of Elizabeth 'to whose name a horrible epithet adheres,' large tracts of country from political causes fell out of cereal cultivation, and forthwith malarial fevers became epidemic, attended with a heavy mortality.

The disturbance of soil that has long been fallow is often followed, both in hot and temperate climates, by the evolution of malaria. A familiar example was the prevalence of intermittent fever in Paris during the construction of the Canal St. Martin; also during the excavations for the fortifications of the same city, in the reign of Louis Philippe; and on a larger scale in different parts of France when the railways were in process of construction.

Malaria is freely generated at the bases of mountain ranges in tropical climates. The strip of land extending along the base of the Himalaya, called the *terai*, is a notable example of this kind. The soil of this region is immensely rich, well supplied with water, and covered with dense forests, which with the vast mountain range makes free perflation of air impossible. At particular seasons of the year it is almost certain death to enter this region.

Some rocks in a state of disintegration, when freely exposed to the drying action of the sun and air, are in tropical countries often highly malarious, and give rise to severe forms of fever. The example most familiar to the writer from personal knowledge is the island of Hong Kong. The soil, according to the late Dr. Parkes, contains only about 2 per cent. of organic matter; but like all granitic rocks it is highly absorbent of water; and Friedell, quoted by the same authority, affirms that it is permeated by fungi. The writer was encamped on this island before it was ceded to the British Government. At this time the soil was but little disturbed, and the troops did not suffer. But when excavations were made at a subsequent time, for the construction of the city of Victoria, on the side of the island facing the harbour, a fatal form of remittent fever appeared, which caused great mortality among both the civil and the military populations.

Parkes (*Practical Hygiene*) thus sums up his account of the soils with the largest organic emanations: '1. Alluvial soils, old estuaries, deltas. Peaty soils are much less malarious. Marshes overflowed regularly by the sea are often healthy, while the occasional admixture of salt water increases the emanations. 2. Sands, if there is an impermeable clay or marly subsoil. Old water-courses. 3. The lower parts of the chalk, where there is a subsoil of gault or clay. 4. Weathered granitic or trap rocks, if vegetable matter has become intermixed; such soils absorb both heat and water. 5. Rich vegetable soils at the foot of hills.'

When malarial fevers appear in ships returning from unhealthy climates, the explanation is to be looked for under one or other of the following causes: (*a*) the sufferers may have had their systems charged with malaria before embarkation, as is constantly seen in the case of invalids returning from India; (*b*) they may have used water on board drawn from a malarious locality; (*c*) the source of the malaria may be in the ship, from decayed vegetable matter mingling with the bilge-water, in ships under a bad sanitary *régime*;[1] or (*d*) it may be derived from malarious mud, as in the case of H.M. ship 'Powerful,' returning from India, when a severe outbreak of fever was traced to this cause. There is, however, reason to believe that when fever has been observed to follow the consumption of unwholesome water at

[1] The writer is indebted to the late Dr. Mansfield, R.N., for an instructive example of a fatal form of yellow malarial fever on board H.M. ship 'Egmont,' long used as a storeship at Rio. The ship was found to be in a state of decay: the timbers were permeated by fungi of a white or cream colour, giving off a sickening and offensive odour.

sea, it has sometimes been not malarial but enteric, from the unsuspected presence in it of the specific germs of that disease.

Instances are also recorded, in which symptoms having a periodic character, and yielding to the treatment which is effective in malarial diseases, have resulted from exposure to decaying vegetable matter, a connexion of which with a special marsh poison could not well be traced.

Attributes.—Malaria, however generated, possesses certain properties well known to those who live in malarial localities. Temperature exercises great influence over its development and activity; many places can be visited with impunity in winter which are dangerous in summer and autumn. Wenzel made observations on the effect of temperature in the development of malaria during the construction of the fortified port of Jahde; he observed that the increase of attacks of malarial fever was coincident with a rise in the temperature. In the charts constructed by him to illustrate the point, a constant precedence of the temperature curve by twenty or twenty-five days of the sickness curve of attacks is to be seen; so that in a temperate climate like that of Jahde, three weeks of increased temperature appeared to be necessary for the genesis of the malarial poison, and the outbreak of sickness. When in any year the medium summer temperature did not reach 12° R. (59° F.) the sickness remained at its minimum.

Malaria drifts along plains to a considerable distance from its source, when aided by winds sufficiently strong to propel, but not to dispel it. Under the influence of currents of heated air it can ascend, in dangerous concentration, far above its source, and buildings elevated some hundreds of feet above a malarious plain are often more under its influence than those on the plain itself. When favoured by ravines and currents of heated air, it can scale mountains to a height which appears to differ in different climates, varying from four or five hundred to two or three thousand feet. It is unsafe to place human habitations on the edge of such ravines on mountain tracts generally considered above 'fever range.' A belt of forest interposed between any malarial place and human habitations affords considerable protection, and a sheet of water similarly placed exercises an absorbing power—facts long familiar to sanitarians. Soils protected from the sun's rays by forest trees are generally healthy; but when exposed to the sun after the forests have been cleared away, malaria is evolved until the land is brought under cultivation.[1]

Pathological Relations.—The physician can demonstrate the existence of malaria by the best of all tests, namely, its pathological action. This action has been recognised for ages in the property it possesses of producing a class of *fevers* distinct from all others in their symptoms and sequels, to which the name of *malarial* or *paroxysmal* has been given; the latter term from the almost clock-like regularity of the periods of apyrexia and recurrence. This subject is fully discussed in a separate article (*see* Intermittent Fever). Pathologists have also recognised its power of impressing on other disorders, in a lesser degree, the same stamp of periodicity, and its more insidious but not less dangerous endowment of inducing that 'slow blight of the constitutional powers' to which the term *malarial cachexia* is now applied. The most striking features of this condition are easily recognised. The sufferers appear much older than they are; the skin assumes a brownish yellow tint, of various shades, according to the natural complexion of the person, and the length of residence in an unhealthy climate. They become anæmic, with an immense increase in the white corpuscles of the blood. The rapidity with which this anæmia is developed is surprising. Professor Kelsch has shown by carefully conducted observations made by Malassez's method, that in twenty-four hours a man affected with intermittent fever lost more than a million of globules per cubic millimètre. This condition of the blood often gives rise to murmurs, not confined to the cardiac region, but heard also in the large vessels, misleading unwary observers into a false diagnosis of organic disease. Persons whose blood is thus affected are prone to attacks of a fatal form of pneumonia, if exposed to cold when not protected by sufficiently warm clothing. Their digestive and heat-generating powers are impaired, and they are liable to diarrhœa from slight causes, often of an intractable kind. The liver is generally enlarged; but the most characteristic lesion is enlargement of the spleen, which often attains such a size as to occupy a large part of the abdominal cavity. There is in the pathological museum at Netley a preparation of the section of a spleen taken from the body of a small drummer-boy, who had been under the care of the writer. This lad had spent some

[1] A popular belief has arisen that the blue-gum tree of Australia, Eucalyptus globulus, is particularly efficacious in this way. This tree is now popularly known as the 'fever tree,' and is being extensively planted for protective purposes in the malarious parts of Italy. Its supposed virtues are said to be due to the camphoraceous constitution of the leaves of this noble, gigantic, and rapidly growing tree. It is a notable fact that the extensive pasture lands of Australia are very free from malaria, and the fact is there attributed to the existence of vast forests of the blue-gum tree.

All the species of eucalyptus grow with amazing rapidity; wherever they are planted they are great consumers of moisture, and thus exercise a drying influence on the subsoil, which must have a considerable effect on the climate where they exist in large numbers.

years of his brief life in the Peshawur valley. The weight of the spleen was 10 lb. 15 oz., that of the liver 9 lb. 10 oz. The condition was alike in both organs, an immense development of connective tissue having taken place. These two organs made up one quarter of the total body-weight of the boy. Both spleen and liver, and sometimes even the brain and spinal cord, are deeply pigmented. The urine is sometimes albuminous, with œdema of the lower extremities—symptoms suggestive of Bright's disease, leading to a grave prognosis, often ill-founded, as the above symptoms usually disappear under good climatic and therapeutic means.

Neuralgic affections, varied and numerous, are common sequels of malarial poisoning; 'brow ache' is a familiar example. To the above may be added palpitation of the heart, rheumatic pains in limbs and joints, and amenorrhœa; and if, as often happens, scurvy be engrafted on the malarial cachexia, such of the above affections as may be present are at once seriously aggravated.

Tropical dysentery prevails in its worst forms in malarial localities; the same is true of suppurative inflammation of the liver. It seems probable that when malaria acts as a predisposing cause of dysentery, it is taken into the system through the medium of water. It is a significant fact, elsewhere insisted on by the writer, that exactly in proportion as we have banished malaria from the soil of the British Islands, so has dysentery disappeared as an endemic disease.

The late Dr. Cutcliff, of the Bengal army, noticed that in some very malarious districts in the Bengal Presidency, large numbers of males were impotent, the women proving fruitful with males from other non-malarious regions. In such localities, also, the children of those affected are often born, not only with the external signs of the malarial cachexia, but also with the visceral changes and pigmented organs described above.

Since we cannot yet affirm that the essential nature of the malarial poison has been discovered, we may notice two other theories that have been advanced. It need only be said of the few who maintain that the grave pathological changes attributed to malaria are all explicable either on the hypothesis of 'chill,' according to Dr. Oldham, or 'certain electrical conditions,' according to Dr. Munro, that they have a difficult thesis to support. If 'chill' will account for the loss of 10,000 men at Walcheren, for the frightful disaster of a like kind at Carthagena, for the terrible visitation of paroxysmal fevers in the Mauritius, and countless examples of the same kind, and for the yearly loss of life in India from fevers—the country in which Dr. Oldham serves—why, seeing that mankind are exposed to 'chill' everywhere, are not such fevers with their sequels universal in their prevalence, instead of being confined to places under one or other of the conditions described in this article? Why, above all, in a country like Great Britain, where vast multitudes of the population are hourly exposed to every variety of atmospheric change, have paroxysmal fevers, once endemic here, disappeared, save in such exceptional places as are still under one or other of the conditions here indicated? No satisfactory answer has been given to this question. As for the 'electrical conditions' of the other hypothesis, when its author can explain what these conditions are, and why they no longer exist in the British Islands, or do not produce their usual effects, we shall be prepared to discuss their value from a pathological point of view.

W. C. Maclean.

MALARIAL.—Pertaining to or connected with malaria; for example, *malarial fever*, *malarial region*, *malarial poison*. *See* Malaria.

MALFORMATIONS (*male*, amiss; and *formo*, I fashion).—Synon.: Fr. *Malformations*; Ger. *Missbildungen*.

Definition.—Deviations from the normal standard, in the size, form, number, or situation of any part or organ of the body.

Varieties and Ætiology.—The malformations of the human body may be conveniently considered under two distinct heads, namely —(A) *Acquired* malformations, more commonly called *deformities*; and (B) *Congenital* malformations.

(A) Acquired Deformities.—Acquired deformities may be the result of disease, affecting, for instance, the spine, which may become curved, or the joints, or the tendons. Similarly, the bones may be the seat of deformity, as from rickets, mollities ossium, or osteitis. Certain injuries and accidents, such as burns, scalds, fractures, and dislocations, lead also to a great number and variety of deformities. Various habits, customs, and occupations, by giving rise to pressure on certain parts of the body, by altering the amount of blood circulating through them, or by interfering with their due innervation, bring about changes in the relative size and shape of the bony or soft textures, and so lead to malformations. It is thus that the brow is flattened by certain tribes of American Indians; the waist deformed, and the corresponding viscera compressed and dislocated, by means of the tight-lacing practised by more civilised peoples; and the feet distorted by many nations, especially the Chinese. Not only is such a striking example as the common depression of the lower part of the sternum in shoemakers a deformity, but the huge development of certain groups of muscles at the expense of others induced by some occupations must be looked upon in the same light, for these, too, are deviations from the normal outline of the human figure. Besides

these cases, which may be termed primary deformities, many others of a secondary kind—that is, dependent on some antecedent change or lesion—are frequently seen. These may occur in organs correlated in growth, as the absence of hair on the face and pubes, and the increase of subcutaneous fat, if from any cause the testicles waste, or if they are removed before puberty. Absence of, or disease in, any part which causes the disuse of other parts, also induces a secondary deformity, as the atrophy and degeneration of a group of muscles, or of a limb, when the nervous supply is in any way interrupted either at the centre or the periphery. The brief reference which has been made to these acquired malformations will suffice, and this article will be devoted to a consideration of the large class of congenital deformities, and of these to such only as are of a general character. Special malformations of organs will be noticed with the diseases of those organs, such as the brain, heart, and liver. Deformities of the chest, which are a subject of the greatest interest to the practitioner, are also separately discussed. *See* CHEST, DEFORMITIES OF.

(B) CONGENITAL MALFORMATIONS. — Since the appearance of the classic work of Isid. Geoffroy St. Hilaire, congenital malformations have been grouped and classified, and their causes determined with such approximate accuracy, that, in place of the superstitious beliefs and incredible absurdities which formerly prevailed, a distinct branch of pathological anatomy has been established —namely, that of Teratology. Instead of considering a monstrosity as a presage of some misfortune, a proof of divine vengeance, an effect of witchcraft, the result of intercourse with the lower animals, with demons, or even with women during menstruation or pregnancy, we now trace it either to a malformation of the original germ, or to some cause interfering with its development, and inducing either an excess or a deficiency of parts or organs. Starting from the normal standard, we find varieties in development of all kinds in two complete series—namely, an ascending series, from a mere supernumerary digit to double or even triple monsters; and a descending series, from the mere default of a digit or organ, or the union of digits, to monsters with scarcely a trace of human structure, forming an almost shapeless mass. Besides these, we may have excess or defect in the size and development of various organs and parts, or of the body *en masse*, leading to the formation of giants and of dwarfs. In other cases, development and size are normal, but the viscera are transposed; and this, too, may be either general or partial. Defects of union, of closure, and of undue division of parts are very frequent. From the moment of fecundation the ovum is exposed to various influences which may alter its normal development; and it depends on whether it is subjected to these at an early or a late stage, as to whether complex or simple anomalies result.

1. **Malformations by Excess.**—Reference will first be made to the formation of monsters by excess. Two ova may be formed in one Graafian vesicle, for double-yelked eggs are well known; but there is no evidence to show that these would form a double monster. Indeed, Professor Allen Thomson found, on incubating a dozen of such eggs, that not one produced a double embryo; whilst Wolff observed two completely separate fœtuses developed upon a single yelk. The arrival of two impregnated ova in the uterus at the same time will probably give rise, not to double monsters, but to twins, and their fusion seems almost impossible. We are thus led to the opinion that monsters by excess depend on an error of development taking place in a single germ by fission or by budding; and this idea is the more readily tenable since Allen Thomson has shown that, in birds, two primitive grooves may be formed on one yelk and in one *area germinativa*, for in this way the most complete cases of double monstrosity can be explained. In confirmation of this theory, the researches of Lereboullet may be quoted. This observer has seen, instead of the single budding of the blastoderma, which is ordinarily developed into the embryo of the fish, two or even three buds marked off; and these, during the process of development, would meet at some point, and in this manner produce parts of distinct embryos where they are separate, whilst a corresponding region of a single organism only would be formed at the point of junction. According to the mode and extent of the junction of the blastodermic buds, the monsters would vary; and so would be derived all the different varieties, from a duplicity of the face or head, or of the upper or lower extremities, to such extreme cases as the Hungarian sisters and the Siamese twins, who were joined by the xiphoid cartilage only, and the twin negresses (Millie and Christine), united by their lower lumbar vertebræ, sacrum, and coccyx. In these cases all the viscera are not completely isolated and double, for in the Siamese twins three peritoneal prolongations were found in the connecting band, and there was a vascular communication between their two livers. In the case of Millie and Christine, there existed a single anus and a single vulva, but two hymens, two clitorides, and very probably two vaginæ and uteri. The Hungarian sisters, Helen and Judith, had but one vaginal orifice, although the upper part of that organ was divided into two, and the two intestines met in a single anus, placed between the four thighs. The Bohemian sisters, Rosalie and Josepha, more recently exhibited, in whom

there is a junction of the posterior wall of the pelvis, presented apparently a single urethra and a single anus, but a double vagina. Still more curious are the monstrosities which are only united by their vertex, as the *cephalopages*, where the two fœtuses are placed end to end; and the *metopages*, where they are placed parallel, face to face, and sternum to sternum. In one of these cases, two normal brains, completely separated by their membranes, were found on dissection. These compound monsters always have a single chorion, a single amnion, and a single placenta, though the umbilical cord may be double. They are always of the same sex, and their capability of living depends on their having an almost completely double organisation, or on one individual being reduced to such a state of atrophy as to be a mere appendage to the other, who is almost normal in other respects. The condition of the brain and of the heart are the most important factors with regard to their viability. They have never transmitted their peculiarities to their offspring.

2. **Parasitic Monsters.**—The parasitic family of monsters are characterised by a more or less rudimentary individual being implanted on, and growing at the expense of another who is fully formed. This parasite may either exist as a supernumerary head, or limbs, or may be almost complete; it may grow from the head, maxillæ, or lower part of the trunk; and when the genitals exist, it is found to be of the same sex as the chief individual. Some of these cases attain to adult life, and if they have any children, these are well-formed. From such instances the transition is easy to those monsters in which the parasite is either included under the skin, or even, during the approximation of the visceral laminæ, becomes implanted inside the abdominal cavity, as is well seen in a specimen in the Hunterian Museum of the College of Surgeons. In these an arm, a leg, or a hand may be found; fragments of bone are common; and even nervous, muscular, or glandular structures may occur. A fibrous capsule is formed around these vestiges, and if they are sufficiently nourished, they may live a kind of vegetative life; but more frequently they degenerate or decompose by contact with the air, and so cause the death of their host.

3. **Malformations by Deficiency.**—In the case of monstrosities by deficiency, we again have every grade, from those almost without human form, to the simplest malformation due to a non-development or defective union of some parts of the embryo. The acardiac monsters are always products of a twin conception; and the amount of their development depends on the period of its arrest, and on the degree of anastomosis between their umbilical vessels and those of the normal fœtus. Slighter malformations are caused by physical or mechanical influences acting on a single individual, or by some pathological lesion. Panum, Dareste, and others, by experiments on this subject, have shown that different degrees of heat and oxygenation, and mechanical shocks, always lead to some malformation, but the same agency rarely produces the same malformation. Lesions of the amnion and placenta, and twisting of the funis around the fœtus, are fertile causes of deformity. On dissection, a large number of deviations are found to be dependent on inflammatory processes, causing morbid adhesions and serous effusions. These interfere with nutrition, and so lead to an arrest of development. Again, as in after-life, so in the embryo, a primary lesion may induce a secondary one, as when club-feet are caused by a defect in the nervous centres. In the production of malformations, causes of a general nature affecting the parents must not be left out of consideration; for syphilis, chronic alcoholism, and hereditary influences are undoubtedly very potent factors. The writer attaches but very little importance to Demeaux's suggestion—unsupported as it is by any valid evidence—that copulation in a state of drunkenness may engender malformations; but he is inclined to give more credit to maternal impressions during pregnancy as an agent in some of these cases. Many examples which are ascribed to such influences are undoubtedly due to other causes; but the numerous well-attested instances in physiological treatises, which prove the effects of both prolonged and sudden, if intense, emotion on the process of secretion, must make one pause before dogmatically asserting that the nutrition and development of the embryo cannot be interfered with in some similar manner.

4. **Transpositions.**—Transposition may affect the entire organism in some of the lower classes of animals, as in certain fishes and molluscs; but in man it is limited to the thoracic and abdominal viscera. The organs normally situated on the right side are placed on the left, and *vice versâ*; whilst those which occupy the median plane are so rotated that the parts which should be found on one side of the mesial line are displaced to the other. Such transposition varies in degree in different cases, sometimes affecting all the viscera, at other times merely one or two organs. The more general cases are stated by Dareste to be due to the embryo heart taking a turn in its early development to the left instead of to the right, which is its normal change. He has artificially produced similar deformities by incubating eggs placed obliquely, so as to subject their extremities to unequal degrees of heat, and cause an excess of development on one side. Bischoff, however, attributes them to an alteration in the normal position of the umbilical vesicle

and allantois, so that the former turns to the left and the latter to the right, and suggests that this might possibly influence the site of the internal organs.

5. **Imperfect Union or Closure.**—A numerous variety of malformations result from an imperfect union of embryonal parts, originally separate—such as hare-lip, cleft palate, spina bifida, &c.; or from imperfect closures of fœtal passages, such as the cervical, thoracic, and abdominal clefts, and in many of the latter cases the viscera are also profoundly modified.

There is no unimpeachable case recorded of true hermaphroditism, that is, where the presence of true sexual glands of both sexes has been satisfactorily established.

TREATMENT.—Many malformations, especially such as belong to the class of acquired deformities, and others due to minor degrees of imperfect union or imperfect fission, admit of benefit by treatment; but as such treatment is of a purely surgical kind, it does not require to be discussed in the present work.

JOHN CURNOW.

MALIGNANT CHOLERA.—A synonym for Asiatic cholera. *See* CHOLERA, ASIATIC; and MICRO-ORGANISMS.

MALIGNANT DISEASES. — This term is applied to certain diseases or types of a disease which tend towards a destructive or fatal issue. First, it is applied to such diseases as cancer, which, in our present state of knowledge, inevitably lead to the destruction of life; and, secondly, to certain varieties of fevers and other acute affections, such as typhoid fever, scarlet fever, small-pox, and cholera, which present peculiarly grave and aggravated symptoms, and frequently end in death. *See* CANCER; HEART, Inflammation of: 2. Ulcerative Endocarditis; and SMALL-POX.

MALIGNANT PUSTULE. — *See* PUSTULE, MALIGNANT.

MALINGERING.—Malingering, in the sense of an elaborate and carefully planned attempt to deceive the medical man, is not very frequently met with in private practice; and although the simulation of various morbid conditions is a common complication of hysteria, the consideration of this branch of the subject will find its more natural place under the heading of FEIGNED DISEASES. The army or prison surgeon, however, must be on his guard against imposture, and must exercise all his diagnostic skill. For his guidance many elaborate works have been written, and much information collected regarding the nefarious way in which soldiers have often outwitted their medical attendants. In our own country, under the conditions of voluntary and short service, the men seldom attempt to do more than plead the excuse of some slight and temporary ailment to obtain remission from guards or drills. Headaches, rheumatism, colic, diarrhœa, and other affections of a more or less 'subjective' order, are naturally difficult of detection; but the surgeon learns gradually by experience, and seldom fails to acquire a pretty shrewd knowledge of the habitual schemer's somewhat narrow range of imposture; and hence it is that, with all its faults, the regimental system of military practice has always worked well, and enabled a sharp look-out to be kept on the troublesome malingerer, whose ingenuity is so unprofitably expended on attempts to shirk his own duties at the expense of his more industrious comrades. Occasionally, however, when the soldier urgently wishes his discharge, he is induced to lay his plans with greater decision, and to resort either to mutilation or to the imitation of chronic disease, and in Continental armies instances of this sort are comparatively common. To avoid the grievous burden of conscription, an infinite variety of artifices have been employed with greater or less success, and the ample literature of the subject bears amusing record to the ingenuity with which these inventions have been carried out. In dealing, however, with the minor degrees of malingering met with at home, we must be very careful not to be over-suspicious, and not to do injustice to a real sufferer whose symptoms seem somewhat vague and incomprehensible. Numerous cases are on record in which the mystery surrounding a fixed and obstinate pain in the back has been cleared up by the rupture of an abdominal aneurysm; and Dr. Spry records, in the nineteenth volume of the *Pathological Society's Transactions*, a most instructive case in point. A typically healthy trooper of the Second Life Guards presented himself at hospital, complaining of very uncomfortable sensations in the œsophagus and stomach, following the swallowing of a bone. Some suspicion of malingering was entertained at the time; but Dr. Spry, impressed by a certain anxiety of aspect, retained the man under treatment, and three days later death suddenly ensued, and the *post-mortem* examination revealed perforation of the aorta, caused by a small spiculum of beef-bone. Facts like this are abundantly suggestive of caution, and of the happy medium between excessive sharpness and undue credulity, which a wide and intelligently used experience can alone confer. Far better is it for us to be deceived twenty times than for unjust suspicion to be directed to the victim of some painful and depressing disease, whose only fault may consist in his inability to supply a sufficiently clear and convincing scheme of sufferings which may be only too real.

ROBERT FARQUHARSON.

MALPOSITION OF ORGANS.—*See* ORGANS, Displacement of.

MALTA.—A warm, rather moist, and very variable winter climate. *See* CLIMATE, Treatment of Disease by.

MALTA FEVER.—SYNON.: Mediterranean Fever; Gastric Remittent, and Bilious Remittent Fever; Rock Fever (Gibraltar); Neapolitan Fever; &c.

DEFINITION.—An endemic disease of long duration, characterised by fever, enlarged spleen, profuse perspiration, constipation; by almost invariable relapses; accompanied by pains of a rheumatic or neuralgic character, and sometimes swelling of joints or orchitis; and characterised in fatal cases by enlargement and softening of the spleen, no swelling or ulceration of Peyer's glands, and the constant occurrence in various organs of a species of micrococcus.

GEOGRAPHICAL DISTRIBUTION.—As far as is known at present this fever is only met with on the shores and islands of the Mediterranean, where it is widely distributed.

ÆTIOLOGY.—Malta fever is probably due to the introduction into the system of a specific micro-organism. This assertion is based upon the following facts: (1) A well-defined species of micrococcus is found in the organs of every fatal case. (2) This micrococcus can be readily cultivated outside the body. (3) Inoculation of a pure cultivation into a monkey caused fever and death after twenty-one days. (4) From the organs of this monkey the identical micrococcus was abundantly obtained. As to how this micrococcus gains entrance to the organism nothing definite is known. There is no evidence that Malta fever is communicated directly from individual to individual. One attack of Malta fever probably confers immunity against a second. *See* MICRO-ORGANISMS.

Age and Sex.—This disease chiefly affects young persons between the ages of ten and thirty; less frequently under ten, and from thirty to fifty; and very rarely above fifty. It does not seem to occur among infants, or if it does it is not recognised. Sex has little influence, but the complaint is more common among men than women.

Station in life.—Malta fever attacks the well-to-do classes, living in large well-ventilated houses, probably in as large a proportion as it does the poor in their more crowded dwellings.

Months and Seasons.—The summer is the season of the greatest prevalence of the disease, and most cases occur in the month of July. A marked diminution takes place in autumn, and it is rare in the winter and spring months.

INCUBATION.—It is impossible to say definitely how long the period of incubation is, but the writer would put it approximately at ten days.

CLINICAL DESCRIPTION.—*Early Symptoms.* For the first week or ten days sleeplessness and headache are complained of, which may be mild or severe; the appetite is absent; there is nausea, sometimes vomiting, and a feeling of weight and tenderness in the epigastric region; constipation is the rule, diarrhœa the exception. The spleen and liver are enlarged, and both may be tender on pressure. Tympanites is uncommon, but may occur, as also may gurgling in the iliac fossa. During this time almost invariably a slight cough with scanty expectoration is developed, and on examination the breathing at the bases is found to be unsatisfactory, harsh and creaking in character, with now and then a moist crepitation. There is no eruption, but the patient suffers from a most profuse perspiration, and a more or less abundant crop of sudamina is developed. There may be a little delirium at night during this time, but this is rare, and is so slight as scarcely to call for remark. Unless there be headache or severe pain in the lumbar region, the patient for the first week or two usually professes that he suffers very little; at the end of this period the headache and acute symptoms usually disappear, and the long and monotonous period of the fever begins, a period which seems interminable alike to medical attendant and patient. The patient's aspect is natural but listless; his tongue is clean; he has a wish for solid food, which must often be denied; and his bowels require the stimulus of an aperient or enema for evacuation.

Later Symptoms.—The profuse perspiration still continues, and day after day the patient becomes weaker and loses weight, until he has scarcely power to stagger a few yards. During this period the temperature often ranges high. The patient sleeps moderately well, has no delirium or restlessness, is uncomplaining, and takes without any ill effect a large supply of fluid food and stimulants. The only 'variation' in his condition is afforded by a rheumatic affection of the joints; one day the knee is found red, swollen, and intensely painful on being touched, a few days afterwards a wrist or ankle may be attacked. Sometimes almost all the large joints in the body are affected in this way, or there may be intercostal neuralgia, sciatica, or an inflamed and swollen testicle. Thus many weeks may pass, but at last the temperature fairly comes down to the normal, and the patient enters on a long and tedious convalescence.

Temperature.—The chief characteristic in regard to the temperature curve in this fever is its irregularity. The type varies from the continued to the intermittent: one case is almost continuous throughout, another almost intermittent; some cases begin with a markedly intermittent type, and pass into the continued, whilst others begin as continued and pass into the intermittent. Some severe cases show a long irregular elevation of temperature, only reaching normal limits about

the ninetieth day. The temperature curve, as a rule, runs high, reaching 104°, 105°, and even 106° F.

Duration. — Patients with Malta fever show an average stay in hospital of nearly ninety days. The length of the fever may vary from fifteen days to as many weeks or more.

Diagnosis.—A severe, rapidly fatal case of Malta fever cannot be distinguished from a similar case of typhoid except by *post-mortem* examination, when the absence or presence of a specific anatomical lesion in the small intestine at once separates the two kinds. If, as many hold, these fevers are caused by the entrance into the body of specific micro-organisms, then it is evident that the most rational and scientific method of classifying them would be by the identification of the parasite peculiar to each. In all cases of Malta fever there is found a minute round or oval bacterium — the specific micrococcus; whereas in typhoid there is found a much larger rod-shaped micro-organism—the typhoid bacillus. Ordinary cases of Malta fever can be distinguished from typhoid by their long duration, the tendency to constipation, the absence of a specific eruption, and the much smaller rate of mortality, which does not exceed 2 per cent.

Treatment.—This is a specific fever, and no drug at present known has any power of modifying its course. The sulphate and salicylate of quinine, Warburg's tincture, eucalyptus, calomel, salicylic acid or the salicylates, carbolic acid, and other drugs have been tried again and again for this purpose, but without any good result. Medicinal treatment must therefore be directed to mitigate severe symptoms. At the beginning of the fever phenazone is often found useful to combat severe headache and sleeplessness. For the constipation a mild aperient or simple enema will very often prove necessary. For the neuralgic and articular pains, hypodermic injection of morphine, and the liniments of aconite, opium, and belladonna will be prescribed. Treatment must therefore be principally directed to keeping up the patient's strength by judicious dieting, and, when required, by stimulants, and by attention to ordinary hygienic principles. Removal of the patient from the affected area does not cut short the course of the fever; but, as in many other diseases, complete restoration to health will certainly be hastened by change of climate.

David Bruce.

MAMMARY GLAND, Diseases of. *See* Breast, Diseases of.

MANIA (*μανία*, fury, madness).—Synon.: Fr. *Manie Suraiguë*; *Délire Aiguë*; *Fureur*; Ger. *Tobsucht*; *Wuth.*

Under the term 'mania' very distinct disorders or degrees of disorder have been described, which we shall speak of as *Acute Delirious Mania*; *Acute Mania*; and *Mania*.

I. Acute Delirious Mania.—Acute delirious mania, or maniacal delirium—whichever we prefer to call it—is something quite distinct from that ordinarily known as acute mania. The symptoms are much graver, the course is briefer and more defined, and the treatment of the one would be quite inappropriate to the other. An outburst of delirious mania may take place after very few and very short premonitory symptoms. Quite suddenly, after a few days or even hours, the patient will display the most violent excitement, which may as suddenly subside, or run a well-marked course of a few weeks; and if it does not terminate fatally, will gradually decline, recovery usually taking place. Such an attack may have its origin in some sudden mental shock, as the death of a friend, a violent quarrel, a disappointment or suddenly announced misfortune; or it may arise in the course or decline of an acute disease, as pneumonia or measles. It may also come on during rheumatism, or after great fatigue, an epileptic seizure, or child-birth.

We cannot tell at first whether the attack will be transient or prolonged. We may try to cut it short by a brisk purgative, and by such medicines as chloral and bromide of potassium, a subcutaneous injection of hydrobromate of hyoscine, or a full dose of sulphonal, and these not infrequently answer the purpose. Sleep is procured, and perfect recovery may take place in a few days. There are patients whose organisation is so unstable that it is thrown off its balance by a cause perhaps trifling, but which produces a tremendous nerve-discharge and complete disturbance of the whole mental functions. But so transient may this be, that one sleep restores the normal equilibrium, and the patient is cured. This condition in females is often called hysterical—*hysterical mania.* There is no special connexion between it and the uterine functions, and it is better to retain the name 'hysterical mania' for a variety to which it may be more appropriately given.

The delirium, however, does not always terminate quickly. If sleep becomes less and less, the mind more and more confused, and quiet and lucid intervals rarer, we may be sure that the attack will be serious and prolonged, and that careful and efficient nursing for some time will be necessary. Where a quiet and airy room can be provided, and a patient's means are sufficient to allow him an adequate staff of attendants, an asylum is not indispensable. He will not require to take exercise in a garden; he will not be dangerous, as some are, to himself or others, though he may be violent and excited. He may be noisy, however, and so not able to remain unless the house is detached. The room should be lofty and cool, the windows protected and darkened; all furniture

must be removed, and the bed made on mattresses placed on the floor, for he will not lie on a bedstead, and attempts to keep him there will end in bruises or more serious injury. Clothes will be torn off; but if the weather is very hot, as is so often the case during these attacks, this will be of little consequence. If it is cold, a strong suit laced up the back may be put on, and underneath it the requisite body-clothes; or a blanket may be placed round the patient, and fastened up the back.

These patients are in incessant motion, singing, shouting, and talking in a string of incoherent utterances, often repeating the same sentence again and again, or a snatch of a song or text, or a rhyme of their own composition. As a rule they are not violent, and do not attack those about them, though they may resist that which is done for them. They may be hilarious and full of glee and mischief, which is a good sign; or terror-stricken, with visions of horrible objects, which is unfavourable. They are wet and dirty; and the urine will be high-coloured, and often retained for a long period. We shall derive valuable information if we are able to take the temperature; but often that is a difficult task. A high temperature is a bad sign; and so is a rapid pulse, if it continues persistently when the patient has not been using violent exertion for some time. The tongue will often become thickly coated, dry, and brown. If it does not, but remains moist and comparatively clean, this is of good omen.

Prognosis.—The prognosis in these cases is upon the whole favourable. The terminations are almost always either recovery or death. The patients are mostly young persons, who recover unless weakened by previous attacks, other disease, or child-birth. Many of the fatal cases, in the writer's experience, have been complicated by tuberculosis.

Treatment. — Sleep in the attacks now under consideration is generally absent, sometimes for many days. Women can last longer without sleep than men, and die much less frequently in acute delirium. If sleep does not come the patient dies, and our great effort must be to promote sleep by various methods. The first question will be whether we are to give drugs to accomplish this; and, if so, what drugs? Opium must not be given; it will not procure sleep, whether given by the mouth or subcutaneously. It may produce a slight narcotism for half-an-hour or so, and, if we increase the dose, will cause narcotic poisoning and death; but in the height of the attack it will not procure sleep. Chloral we may try in combination with bromide of potassium, giving half-drachm doses of each, and watching the effect. In most cases, sleep of longer or shorter duration will be caused by these drugs; and although it may be short, it may be sufficient to save the patient's life, and enable him to battle successfully with the disorder. In the writer's experience, many more of these acutely delirious patients died before the introduction of chloral than since. Yet it must not be given in enormous or repeated doses, and a considerable interval should elapse between them. It may be administered easily in stout or ale, and often in wine. We may also give sulphonal, or that powerful but somewhat dangerous drug, hyoscine. Such drugs as these are not to be administered frequently, or at regular intervals. We wish to procure sleep enough to prevent the patient from dying by exhaustion; but in this very acute form no medicine is likely to produce more than a short sleep, and is more likely to do this if not given too frequently, and less likely to produce bad effects.

Next to sleep, the most important matter is food. To enable the sufferer to withstand the exhaustion, which is the cause of death when a case ends fatally, he must be fed frequently and liberally. These patients rarely refuse food, but require careful coaxing and feeding; and a skilful attendant will give something every two or three hours—minced meat and vegetables, or bread and milk, beef-tea, eggs, and the like. Brandy often produces great excitement at the onset and height of an attack, and stout or ale is more suitable, and more likely to bring about sleep. We may give also plenty of lemonade, barley-water, and such drinks, if there be great heat and thirst.

Although this unconscious or semi-conscious delirium may continue for many days, yet in almost every case the violence and excitement are paroxysmal, with intervals of comparative calm, even if there be no sleep. Judicious attendants will avail themselves of these quiet intervals to administer food, and keep the patient in the recumbent posture, thus ensuring rest, instead of letting him be continually on his legs wandering about the room, and so exhausting his strength. And when held down quietly, with cold cloths applied to the head, or his face fanned by the nurse, he is not unlikely to drop off to sleep.

Can sleep be procured by other means? The French have advocated prolonged hot baths, but they are attended with considerable danger. We may try a bath of half-an-hour at 90° or 92°, allowing it to become cooler, but it is of no use attempting this unless the patient submits to it without a desperate struggle. Cold to the head may be applied, because it is soothing and grateful to the sufferer, though it is a question whether the circulation in the brain is much affected thereby.

The bowels may be kept open by a dose of calomel administered in the food, or half-a-grain of podophyllin. Active purgation is inadmissible except at the very outset, and

enemata cannot easily be given in the violent stages. It used to be the fashion to apply blisters to the nape of the neck or calves. This is most unadvisable, for such parts may become very sore, owing to the restlessness of the patient, and thus deprive him of sleep. Neither is it necessary to cut all the hair off, which in the case of a lady may be a very grievous matter. If very long, it may be shortened without being cut close to the head.

II. **Acute Mania.**—Quite different from the unconscious raving of maniacal delirium is the conscious but violent excitement to which we give the name of *acute mania*. The former is a disorder dangerous to life, running a rapid course to death or amendment in a week or two. The latter may go on for weeks or months with little danger to life, but with excitement so troublesome that the sufferers require the restraint and discipline of an asylum. Though most insane, full of delusions and outrageous habits of every kind, they know what they are about, and are all the more mischievous in consequence. They can take every advantage of an opportunity, and know how to exasperate those about them. They generally eat well, and sleep indifferently, but sufficiently to support life; and their bodily health often remains wonderfully good considering what they go through. They will destroy clothes, windows, bedding, and deny or justify all they have done. The termination is not usually fatal, unless the health gives way through some other disease. The patients generally recover gradually, or sink into chronic mania or dementia.

Prognosis.—The prognosis in cases of acute mania will depend upon circumstances. (1) The number and duration of the attacks are important. In a first attack the prognosis is favourable. If recent, we may have hopes, even if there have been preceding attacks of a like character. (2) If the patient is not of advanced age or of broken health, the prognosis is favourable. (3) If the mania consists of violent, turbulent conduct, rather than of fixed delusions, as is frequently the case, there is more hope. If the patient hears voices, the prognosis is bad. If there are delusions which impel him to refuse food, and he does so persistently and violently, it may be difficult to give sufficient nourishment, and he may sink from exhaustion, or become a chronic maniac.

Treatment.—Patients suffering from this form of mania do not require, like the last, to be kept in one room; on the contrary, they should take plenty of exercise in the open air. This will promote sleep more than drugs, though we may give an occasional dose of chloral hydrate, or bromide of potassium, or the latter with chloral hydrate or with Indian hemp. Such medicines, however, should be given only to procure sleep, not to allay excitement; we may also try sulphonal or hyoscine. In many cases, however, sleep procured by drugs appears to prolong the attack, and, where there is no danger to life, it is better to omit them, and to let natural sleep come after the fatigue of exercise. Plenty of food is required, for the waste is great.

Patients of this kind are not to be cured or even kept without discipline and moral treatment; and great tact, firmness, and patience are required for their management. They may be very dangerous and spiteful, will know how to provoke attendants, and how to take them unawares if off their guard. Moral treatment will be far more efficacious than drugs, but it can only be carried out in an asylum. Patients in this condition, if kept in private houses, must be rendered quiet by drugs; but there is great fear lest by this method the disease, instead of being cured, may be converted into a chronic and incurable mania.

III. **Mania.**—A great variety of cases are grouped under this name, arising from various causes, but alike in the fact that they are marked by excitement rather than depression, by exaltation or wrath, but not by gloom. Excitement and noisy and irrational conduct characterise some, but most patients present delusions coinciding with their temper and bodily condition when in health. Almost always this form of insanity is marked by delusions, if it lasts long enough; but sometimes a short burst of excitement—a transitory mania—may pass away without the stage of delusion being reached.

The diagnosis of an ordinary case of mania is not difficult. The prognosis must depend on the cause; the age of the patient; the character of the delusions, if there be any; the occurrence or non-occurrence of previous attacks, and their history. Attacks of mania are frequently recurrent, and may be repeated again and again through a long life; recovery may take place on each occasion, or the disorder may at last turn into chronic mania or dementia. The period of excitement in many cases is followed by one of depression, and these may alternate with great regularity for twenty or thirty years; and even when the patient is sunk into hopeless dementia the period of excitement may occur as regularly as before the mental powers had given way.

Treatment.—Of the treatment of these cases a great deal cannot be said. The majority will require the care and vigilance to be found in an asylum, at any rate during the excited stage. The intervening or rational period will often be prolonged advantageously by removal from the asylum; and when this is the case there will be frequently found less reluctance to return to it when the necessity arises, and instances are not uncommon of patients even themselves seeking its shelter.

G. F. Blandford.

MANIPULATION (*manus*, tho hand). A mode of investigating and also of treating diseases by the use of the hands. *See* PHYSICAL EXAMINATION; FRICTION; MASSAGE; and SHAMPOOING.

MANITOU SPRINGS, in Colorado, is famous for its mineral springs and as a high-altitude station, being situate 6,370 feet above sea-level, in a sheltered valley of the Rocky Mountains at the foot of Pike's Peak. The climate is that of Colorado Springs, six miles distant (*see* COLORADO SPRINGS), and the mineral springs consist of: (1) alkaline and saline, useful in kidney and liver affections; and (2) chalybeate alkali (the iron ute), of repute in uterine disease. The climate has been found valuable in the treatment of chronic phthisis. The neighbourhood of the great tracts of Manitou and Estes Parks, 1,000 to 1,200 feet higher than Manitou Springs, being available for camping-out, is an additional attraction.

MARASMUS (μαραίνω, I grow lean).—A synonym for general wasting. *See* ATROPHY, GENERAL.

MARIENBAD, in Bohemia.—Alkaline sulphated waters and mud baths. *See* MINERAL WATERS.

MARSH FEVER.—A synonym for intermittent fever. *See* INTERMITTENT FEVER.

MASKED.—A synonym for larvated. *See* LARVATED.

MASSAGE.—SYNON.: Medical Rubbing; Mechanotherapy; Fr. *Massage*; Ger. *Massiren*.

DEFINITION.—A series of mechanical movements, best executed by the hands of the operator, affecting not only the skin, but also the deeper structures of the body.

MODES OF ACTION.—Massage acts in the following ways: (*a*) it quickens the flow of the fluids (blood, lymph, chyle, and others); (*b*) it increases secretion and excretion; (*c*) it excites muscular action.

METHODS.—The movements in massage are of several kinds: (1) Stroking, or *effleurage*; (2) Pressure, or *pétrissage*; (3) Percussion, or *tapotement*; (4) Vibrations; (5) Passive movements; (6) Active or Swedish movements; (7) Medical gymnastics.

Stroking is performed by lightly drawing the hand in one direction over the surface of the part: on the head from the vertex, and on the spine from tho neck, downwards; on the limbs, from the extremities towards tho trunk. When *friction* is employed, greater pressure is made, and thc hand is moved to and fro.

Prcssurc (squoezing, kneading, rolling, &c.). The pressure and relaxation should be alternate and rhythmical, simulating natural muscular action. During the pressure the veins, capillaries, lymphatic ducts, and lymph spaces are emptied; and the valves in the vessels preventing the return of the expelled fluids, room is made for a fresh supply.

Percussion (tapping, beating, pounding, and others) causes muscular contraction.

Vibrations act in a similar manner.

Passive movcmcnts.—All the normal movements of the joints are fully executed by the operator, the will of the patient being in abeyance. The synovia is increased, if scanty—absorbed, if in excess; deposits around the joints are removed, and nutrition is promoted.

Active or *Swedish movements* are performed with the combined help of the patient and operator. The will of the patient is concentrated on the muscles under treatment. The patient is directed to cause a muscle to act, and the operator resists the movement, employing slightly less force. When the muscle has fully contracted, the operator employs more force, whilst the patient, diminishing but not ceasing his resistance, allows the part to be brought back to its original position. This is repeated a suitable number of times, but never so as to cause muscular exhaustion.

Medical gymnastics have for their object the bringing into action those muscles which are seldom employed, or which, for some special reason, require strengthening.

USES.—The maladies, both medical and surgical, for which these therapeutic agents have been employed with success are very numerous. It must suffice to mention the following: Muscular weakness and wasting; infantile paralysis; Bell's palsy; lead palsy; neurasthenia; neuralgias; sciatica; peripheral neuritis; anæsthesia; hyperæsthesia; chorea; hysteria; occupation palsies; some forms of arthritic disease, as rheumatoid arthritis and chronic rheumatism; and the morphine habit.

JOHN FLETCHER LITTLE.

MASTALGIA } **MASTODYNIA** } (μαστός, the breast; and ἄλγος, or ὀδύνη, pain).—Pain in the mammary gland. *See* BREAST, Diseases of.

MASTICATION, Disorders of.—In the mouth the food is submitted to the action of the jaws, carrying the teeth; is movod about by the tongue; and is kept between the teeth by the lips, cheeks, and tongue. The muscles which perform the complicated and nicely adjusted movements of mastication are supplied by the third division of the trifacial, the facial, and the hypoglossal nerves. These movements are essentially voluntary, the stimuli which determino them being central in origin, and passing to the muscles by the above-mentioned nerves; but, at the same time, the mere contact of the buccal mucous mem-

brane with food aids in determining the movements, afferent impressions travelling to the brain by the fifth pair of nerves.

Mastication is liable to be disordered from various causes.

1. *Muscular Paralysis.*—Imperfect performance of mastication is frequently the result of cerebral lesions, such as hæmorrhage or tumours. Dependent on the seat and extent of these will be the extent of the paralysis, which may vary from an impaired movement of one cheek, thus permitting the food to collect between it and the gum, to almost an absolute inability to move the lower jaw from side to side, or to close the mouth.

There are several special forms of paralysis in which the movements of mastication are affected, either alone or in common with other muscles of the body.

(*a*) *Labio-glosso-laryngeal paralysis* is especially characterised by the impairment of mastication and deglutition, which progresses from a mere escape of saliva, due to paralysis of the orbicularis oris, to complete inability to perform either act. Of the masticatory muscles, it is those of the tongue and lips which are mainly affected. As the disease progresses to its invariably fatal end, the palsy increases in completeness.

(*b*) The loss of power in the muscles of mastication associated with *diphtheria*, is far less frequent than paralysis of deglutition, and is usually limited to some weakness of the tongue, and less often of the lips and cheeks.

2. *Muscular Spasm.*—Trismus, or tonic spasm of the muscles of mastication supplied by the motor branch of the fifth nerve, is rarely unilateral. The jaws are usually completely locked, and incapable of separation, thus rendering mastication impossible. The trismus may be a part of a general condition of tetanus, or may be the sole indication of spasm; and in the latter case is usually reflex in origin, being determined by such causes as dental irritation, or facial neuralgia, or, more rarely, by distant wounds or intestinal worms.

Irregular clonic spasms of the muscles of the jaws, such as are frequently seen in epilepsy and hysteria, and are evidenced by chattering and grinding of the teeth, will offer some difficulty to the proper performance of mastication.

Spasm, whether tonic or clonic, when limited to the facial muscles supplied by the seventh pair, will interfere but slightly with mastication. By preventing the action of the lips and cheeks, the food will not be so easily kept between the teeth, and the saliva will dribble from the unclosed mouth. Nor are the impulsive spasmodic movements of the tongue, as seen in chorea, important as impairing the proper mastication of the food.

3. *Affections of the Temporo-maxillary Articulation.*—Chronic arthritis may lead to such serious disorganisation of the joint as to impair its movements, ankylosis occasionally occurring.

4. *Morbid Conditions of the Mouth.*—Inflammation of the mouth or tongue, and disorders of the teeth, render mastication difficult. Enlargements of the salivary or lymphatic glands, tumours of the thyroid body, epulis, and new-growths of the tongue, as well as abnormal apertures in the palate, floor of the mouth, or cheeks, caused by ulceration or noma, may interfere with mastication.

Effects.—Portions of food imperfectly masticated may produce suffocation, by blocking up the entrance of the glottis, or lodging in the gullet. Imperfectly masticated food, when swallowed, is a well-recognised cause of dyspepsia.

Treatment.—The treatment of disorders of mastication naturally consists in the removal of their cause, when possible. The reader is referred to the articles in which the several conditions are fully discussed.

W. H. Allchin.

MASTURBATION (*manus*, the hand; and *stupro*, I ravish).—Synon.: Fr. *Masturbation*; Ger. *Selbstbefleckung*.

Definition.—The excitement of the sexual organs by unnatural means.

Ætiology. — Masturbation is practised under a variety of circumstances. First, in infants and young children, local irritation situated beneath the prepuce in males, or within the vulva in females, leads to manipulation of the parts, and to consequent pleasurable excitement, which is constantly renewed, with an entire unconsciousness of the meaning of the practice. As an instance, the writer was consulted by a mother about the extreme delicacy of her boy, then little over four years of age. No tangible disease being evident, the little fellow was stripped, with the view to a more complete examination. Whilst this was being made, the child was seen to rub his penis with the hand in the most careless manner, causing thereby an erection—an observation which explained the cause of the ill-health.

The second class includes individuals who have reached or are near the age of puberty, and have either accidentally learned, or been taught, this pernicious habit. *Balanitis* is a frequent exciting cause. *Pruritus vulvæ*, due to diabetes or other causes, may lead to it in the female.

A third class of cases may be mentioned, in which the practice has a central origin, in certain forms of brain-disease or cerebral deficiency, as is seen in some forms of insanity and in idiocy.

Effects and Symptoms.—There is no doubt that the excitement incident to the habitual and frequent indulgence in the unnatural practice of masturbation leads to

the most serious constitutional effects. These effects are more especially manifested in the nervous system, the functions of which are perverted. The mental faculties become more or less affected; and often great despondency, loss of memory, irritability, prostration of strength, headache, and neuralgic pains ensue. Facial acne is a common symptom. Anæmia, accompanied by the habit of blushing, occurs; and the functions of the heart are disturbed. Digestion is disordered. There is general loss of health and strength; and chronic hypochondriacal invalidism, if not worse, is set up. In certain cases the urinary organs are affected; and the writer has observed in several instances the presence of albumen in the urine, which would seem to be the result of some reflex action on the nerves and vessels of the kidney. The effects on the male genital organs themselves are marked. There is extreme irritability of the neck of the bladder and adjoining parts, accompanied by discharge of mucus and of prostatic secretion, often mistaken for semen. At the same time seminal emissions are prone to occur on the least sexual excitement, either by day or during sleep; and in extreme cases there is impotence. In the female the natural feelings are often lost.

Diagnosis.—In many cases of masturbation in young men the diagnosis is sufficiently easy; for such persons, alarmed by reading the advertisements and books written specially to excite feelings of shame and fear, and to bring the subjects of them within the nets spread abroad by quacks, are sufficiently ready to declare the cause of their distress. In other cases, in which the practice is concealed from fear of the consequences, or from innocent unconsciousness of its nature—and this is more especially the case in females—the diagnosis is often very difficult. When, however, the symptoms just described are present, in the absence of any cause to account for them the practitioner may entertain a reasonable suspicion of the existence of this habit, although it may be difficult in many cases to carry his impression beyond the suspicion.

Treatment.—In the first class of cases above mentioned—that is, in very young persons, in whom some local irritation exists—the source of this irritation must be found and removed. Sometimes it may be an elongated prepuce, with irritating matter beneath it; in such cases circumcision may be required. In females cleanliness and simple lotions may suffice; or irritation, caused by the wandering of thread-worms, or in other ways, may require to be treated. In these cases attention to the general health, to the state of the digestion, to the urinary secretion, and to the bowels, should not be neglected. Diabetes must be treated if present. Extreme watchfulness by the nurse is necessary, and at night it may be even necessary to secure the hands by muffling or tying them behind the back.

In young adults the moral sense must be acted upon. It has been suggested, by way of prevention, that judicious and kind advice may with advantage be given before even a knowledge of the habit is acquired; whilst too much vigilance cannot be exercised by those who direct and assist in the management of schools.

In the actual treatment of the effects established by masturbation, it is of the highest importance to improve the health, both mentally and bodily. Early rising, healthful exercise, careful diet, and travel if practicable, should be recommended. Remedies directed to the treatment of symptoms connected with the nervous, circulatory, and digestive systems will be required. Of course the habit must be entirely stopped, and all thoughts of a loose or libidinous character must be avoided. The bromides, especially the bromides of potassium and ammonium, are very useful for lessening sexual excitability; and, in the case of females, these may be more especially needed at the close of, or just after, the catamenial periods. In certain cases where these remedies, together with steel, and other appropriate drugs, have failed to diminish the frequency of the seminal emissions which are common in males, caustics may be applied to the neck of the bladder. *See* Spermatorrhœa.

MATLOCK, in Derbyshire.—Thermal waters. *See* Mineral Waters.

MAW-WORMS.—A synonym for thread-worms. *See* Entozoa.

MEASLES.—Synon.: *Morbilli*; *Rubeola*; Fr. *Rougeole*; Ger. *Masern.*

Definition.—An infectious specific fever, with an eruption, on the fourth day after catarrhal symptoms, of a deep-red spotted rash; this is at first slightly raised, and is distributed in crescentic groups, which soon extend over all parts of the surface; it persists as a general mottling after the subsidence of the fever, and where intense may cause a fine desquamation. The disease prevails as an epidemic, and spreads by direct infection. It very rarely attacks the same person more than once.

Ætiology.—Contagion is the cause of measles wherever it is now met with. In large towns, where sources of infection always exist, epidemics recur about every four years, chiefly among children, as fresh series of the susceptible become exposed. Few adults suffer; most of them having been attacked in childhood. Among scattered populations long periods may elapse without infection reaching them; when it does, neither age nor sex influences directly either the liability to attacks, or their severity.

The contagium of measles, except in the catarrhal stage, is not far diffusible in the air, but clings to surfaces, and may so be carried from place to place. Children with full eruption have been brought into a house among others, and nursed in a room apart, without any extension of the disease even to the most susceptible. When young infants are said to escape infection, it is where the family is small, and they are less exposed.

Measles in a school or family is sure to spread; the catarrhal stage, infectious throughout, is mistaken for a common cold, and no timely separation is attempted. The cough is an important means of conveying infection at this time.

The period of incubation is ten to twelve days, rarely a day or two more. During the latent stage of this long incubation, those who have been exposed to infection are thought to have escaped, and are sent to begin the same round elsewhere. The disease may be conveyed by *fomites.* Infection begins before the rash appears, and the contagium may be given off by the third day, most probably during the greater part of the period of incubation.

Contagium.—The contagium principle, developed only in the bodies of the sick, is found during the height of the disease in the tissues, the secretions, the blood, and the breath. Inoculation at this stage either with the blood or serum, by Home, Cullen, and others, reproduced measles without modification; the primary fever then appearing on the seventh day, and the eruption on the ninth and tenth. Mayr, of Leipzig, twice conveyed the disease by means of nasal mucus. Catarrh began on the eighth and ninth days; rash on the tenth and eleventh. A big dog after licking the hands and face of a child ill with measles had coryza a week after, and died in the following week with fever and bronchitis; spots of measles-like congestion were found in the pharynx and trachea, with engorgement of the lymphatic glands. After an attack of measles personal infection is mostly over in a month; it may persist longer, or be conveyed somehow by convalescents for another month. Infection may linger long in closed rooms, or cling to bedding and articles of clothing unless stoved; such disinfection lessens the fatality among further cases of measles, as well as the spread of the disease. After two years of age the mortality is not greater for children in proportion to the numbers attacked than at other periods of life; and there is some advantage in contracting this disease at a time when careful nursing and individual attention can be secured. Those who escape measles during childhood are very likely to be seized on taking their place in mixed communities.

Anatomical Characters.—The mucous membrane of the larynx and trachea is always red in measles, often with punctiform congeries of vessels; and not infrequently thin films of lymph are found loosely adherent. In fatal cases the bronchi are congested, sometimes with exudation on the lining membrane, more frequently covered with muco-pus, or plugged with catarrhal mucus; capillary bronchitis with broncho-pneumonia is frequent. Lobar pneumonia, if extending to the surface, is accompanied by pleurisy, often limited to the part of the lung affected. Fluid may be found effused into the pleura and pericardium. Petechiæ are often found on the pleural surfaces. Any inflammatory signs in the serous membranes, cardiac or articular, are rare. All the internal organs are congested, and show hæmorrhagic spots. The cranial sinuses are full; there is hyperæmia of the meninges and brain-substance, and increased fluid in the ventricles and subarachnoid space; more rarely recent lymph is seen on the surface of the hemispheres; deposits at the base belong to later consequences of the disease. Congestion of the digestive tract is most marked near the ileum and colon: externally the distended veins of the submucous coat are seen; internally there is deep redness of the surface, the solitary glands are distended and elevated, the agminated to a less degree, but there is little or no enlargement of the mesenteric glands. The follicles of Lieberkühn and the tubular glands of the large intestine are more distinct than usual. A chronic ileo-colitis may result. The liver is mottled; both the portal and hepatic veins are full; and the lobules are ill-defined and granular in appearance, with fatty particles interspersed. The bronchial glands are often enlarged, and sometimes softened; suppuration from them extended up behind the œsophagus in one instance. The lymphatic glands of the neck are always congested and enlarged, and often those elsewhere, as in the axilla or groin. The spleen is swollen and friable; or very little altered. The kidneys show no distinctive changes; they are hyperæmic in the earlier stages of the disease, and the tubules may then be full of epithelium and cell *débris.* The degree of after-congestion depends much on the degree of pulmonary obstruction, or on early exposure to cold or fatigue; no albumen or casts of renal tubes are found in the urine, unless a secondary nephritis have been thus occasioned.

Symptoms.—The symptoms of measles seldom occur until eight days after exposure to infection. They may begin suddenly, with high fever, aching pains, and vomiting, the initial fever subsiding next day, but not completely, when there may be little feeling of illness, but some signs of coryza, cough and sneezing, with enlargement of the lymphatic glands in the neck. On the third day the coryza is more marked, the cough often very troublesome, and the fever increased.

Some few spots of eruption are now visible on the forehead and sides of the face. The conjunctivæ are injected, the tonsils full and smooth, the soft palate mottled, the tongue furred, the pulse quickened. On the fourth day the eruption appears more fully, with rapid pulse and sudden elevation of temperature, often to 104° by night, with delirium. On the fifth day, with full rash, there is marked alleviation of all the symptoms: the cough is quiet, unless lung-mischief mark the crisis; the pulse is less full and frequent; the tongue cleans; and the temperature, already fallen by 3° or even 4°, often reaches the normal by the sixth day, leaving the skin still deeply stained by the fading rash, and the patient weak. During the next week or ten days there is a tendency, not only to depression, but to sudden rises of temperature, with various complications that retard or endanger convalescence. We notice three stages—the *ingress*; the *eruption*; and the *decline*.

The Ingress.—The ingress of measles is not always with marked initial fever. Coryza and spots of the rash may be observed before illness is complained of, though some elevation of temperature can be traced for three days before the full eruption. This febrile movement has been preceded in some cases, where thermometric observations were made throughout the period of incubation, by a well-marked depression before the initial fever, and then vomiting or headache, vertigo, chorea, eclampsia, and other irregular symptoms may occur. Often some slight disturbances of health, and even cough, have been observed all through the incubation-period; sometimes an intercurrent disease has delayed the regular march of the invasion to seven or eight days, or the latent stage has been prolonged to ten or twelve days, or these days may be febrile from a concurrent influenza or herpetic catarrh. The infection of influenza, received after that of measles, in one case delayed the invasion by ten days. The eruptive fever always occupies four days. As this approaches the crisis, many symptoms are aggravated. Incessant cough occurs, often in children with croup of the catarrhal kind; bronchial irritation with *râles* and rhonchal fremitus, or possibly submucous rhonchus, may be heard at the pulmonary bases; the respirations, hurried and shallow, are 30 to 40 in the minute; the pulse is quickened to 130 or 140. Both the respiration and the pulse, especially the former, are more accelerated in young children; and with them convulsions may at this period retard the eruption or prove fatal. Death before the rash is thrown out, though rare, has also happened in adults. The urine is scanty, yellow or dark-coloured, and deposits lithates; at the crisis it has been suppressed for forty-eight hours. Abdominal pain or diarrhœa often occurs at this time, and the latter may become a serious symptom. Thirst is great; the lips are dry; the tongue is moist, with red papillæ showing through a thick white fur. The palate and fauces are red, from many punctiform congeries of vessels. The deep injection and swelling of the pharynx may extend to the Eustachian orifices, and cause deafness. Deglutition is painful, and sometimes difficult, from the imperfect closing of the turgid epiglottis, as well as from fulness of the tonsils. With these throat-symptoms, the gland at the angle of the jaw is somewhat enlarged and tender; but there is not much swelling or œdema of the overlying integument. The lymphatic glands of the neck are palpably enlarged before there is much or any rash on the skin, those of the axilla and groin afterwards. Epistaxis is not rare. The eyelids are swollen, the conjunctiva being inflamed and purulent; intolerance of light is complained of; and there is risk of the eye being permanently injured. The nocturnal delirium and most of the urgent symptoms abate when the eruption of measles is completely out.

The Rash.—The rash of measles first shows itself on the face or shoulders, in distinct red spots, in circular groups or much scattered; fresh spots soon show in the clear skin. They begin as red points, which are raised, and feel rough or 'shotty,' especially on the face, and early in the eruption; they then form crescentic groups, which coalesce into patches of irregular outline on the body. The face, soon disfigured by the swelling, is first covered; then the neck and chest. The rash is also well-marked in the scapular region, extending to the rest of the trunk and to the extremities on the second day, becoming more sparse as it descends. A peculiar and offensive odour from the sick is recognisable during the whole eruptive period. The rash declines in the order of its invasion. Within twenty-four hours the swelling of the face subsides; the red spots, no longer raised, become pale under pressure, and leave a yellowish discoloration, or on the shoulders marks of a dusky red. Considerable irritation attends the rash, continuing with it to the third day or longer. At this time fine desquamation is noticed on the face; small scales of cuticle are detached from the top of the enlarged papillæ, so that most of the surface is furfuraceous; this disappears with the irritation by the second week, or may persist a week longer; it does not occur when the eruption has been slight, hardly ever on the fingers and feet, and never in large shreds. A coppery, mottled discoloration remains on the more vascular parts of the skin, or where the rash has been most marked, for eight or ten days, and sometimes continues visible three weeks from the commencement of the illness. The eruption may begin on other parts of the body than the face, as at

the seat of any injury to the skin. The disease may run its course safely with very little, possibly without any, eruption. An imperfectly developed dusky or livid rash is met with in severe cases; a full rash may recede on serious lung-complication. Petechial specks may accompany a moderate eruption, or hæmorrhagic spots complicate the irregular forms. Some of the earlier spots may not only be raised and acuminate, but minutely vesicular at their apices. In the dark races the eruption is yellowish, raised above, but somewhat lighter in colour than the surrounding integument; in the mulatto it varies from a yellowish to a dusky brown; but all other signs of the eruptive period are well marked.

The Decline. Complications and Sequelæ. The pulmonary lesions of the febrile stage, capillary bronchitis or broncho-pneumonia, may delay defervescence, or rapidly prove fatal. With moderate lung-mischief the fall of temperature following the rash is often very marked; and, with extreme depression, further congestion of the lung may occur. The liability to depression of temperature which follows many acute fevers is specially marked in this one, and requires to be guarded against. A tendency to sudden elevations of temperature is also noticeable for ten or twelve days after the eruptive fever subsides; rarely this has been accompanied by a recrudescence and reappearance of the rash: a true relapse is hardly known. The common accidents of this period are—first, a return of cough in children; this may be croupy, beginning the very day of the first decline of temperature. The temperature again rises suddenly, perhaps to 103°, with greatly excited pulse and respiration. Next day there is tracheal rhonchus, but no increased size of the cervical glands. The cough then becomes looser, and thin shreds of false membrane are expelled. This form of membranous croup is as common from three to six days after the rash, as catarrhal croup is the day before the rash. It rarely attacks more than one child in a family; this is sometimes the same child who had laryngeal symptoms in the catarrhal period. In some epidemics laryngitis and subsequent hoarseness have often followed. More frequently a return of cough, or of short hurried breathing, indicates the commencement of bronchitis or of broncho-pneumonia. The air-passages are left in a specially irritable state after measles, so that the chest must always be looked to. The eyelids also need care. Otitis may cause a high temperature of short duration. Three or four febrile interruptions may happen in a single convalescence. Serious complications, not attended with much temperature-disturbance, are found in diarrhœa, dysentery, and passive hæmorrhages. Enteritis, with diarrhœa and dysentery, is as fatal and frequent a complication of this disease in hot climates as are pulmonary affections with us. In convalescence, after a critical increase of urine, the kidneys act more freely; if during pulmonary obstruction the chlorides were diminished, they now reappear, the excretion of urea is increased, and uric acid may be eliminated in excess. Albuminuria, unless determined by extreme neglect and exposure, is not often a consequence of measles.

Impairment of health results as often from this as from any other specific fever. Nerve-waste may lead to imbecility and dementia. Acute tuberculosis is started, or tubercular deposits begin after measles. The strumous diathesis is evoked, and may set up a troublesome ophthalmia, with danger to the cornea; or a fatal ulcerative stomatitis. Abrasions of the nares or lips may persist or extend, eczema or ecthyma appear, and glandular enlargements increase or become chronic. Even in the robust acute pulmonary disease is readily induced by exposure or want of care during convalescence; a liability to this, to pustular eruptions, and for three weeks to irregular febrile disturbance, may be noted. It has happened that some nervous disorders, such as chorea, epilepsy, or mania, have been arrested during an attack of measles, and with permanent benefit. Measles not infrequently co-exists with mumps and with whooping-cough, more rarely with varicella and vaccinia. Either of these, taken with measles, is delayed or interrupted, resuming its course when the eruption of measles is over. Whooping-cough, established beforehand, is temporarily interrupted by an attack of measles. Scarlet fever may complicate measles; also erysipelas; or measles may be contracted in the course of typhoid fever. Diphtheria is not so frequent a complication of measles as it is of scarlet fever. After any of these diseases the liability to suffer infection from the others seems to be increased. The exemption from a second attack of measles is not universal, but the exceptions to the rule are so few as to be rarely observed. Some persons protected by a previous attack have had catarrh, with transient rash, while in attendance upon children with measles. In two instances observed by the writer, at intervals of fifteen and twenty-five years respectively from the primary attack, the rash was preceded by the usual catarrhal fever, and was but slightly, if at all, modified. Out of numberless mistaken cases, no others have come under his notice. An allied form of rubeola (*sine catarrho*), essentially distinct, is commonly mistaken for measles; hence the belief in second measles.

Mortality.—The fatality of measles is increased by extremes of heat in hot countries and seasons, and by extremes of cold in cold climates; by malarial soil, vitiated air, or crowded dwellings; by defective diet; and by scurvy.

The annual mortality from measles in London is nearly five per ten thousand. The deaths from measles are about one per cent. of all deaths in England and Wales, and nearly two per cent. in large towns; this is higher during epidemics, but has not reached much beyond 2·7 in London. The proportion of deaths to attacks varies from twenty to thirty per cent. in crowded wards, to one or two per cent. in healthy houses; the mortality of ten or twelve per cent. is a common estimate. Among young children the deaths are in equal proportion for the two sexes; more than half of the whole number of deaths from measles are of children under two years of age; the proportion thence progressively diminishes. This differs from what is observed in scarlet fever and diphtheria; moreover, the proportionate fatality of these latter diseases in the two sexes is greater for girls.

Pathology.—Measles is the type of a zymotic disease. A bacillus, recognised by Drs. Canon and Pielicke as specially concerned, is described in the *Berliner Klin. Wochenschrift* of April 18, 1892. It was found in the blood, mostly on the sixth day of the disease and for a day or two after the crisis; also in the nasal, conjunctival, and bronchial secretions. Ten years ago Dr. A. Ransome obtained some such particles from the breath of two persons suffering from measles. Drs. Braidwood and Vacher subsequently confirmed this observation. Glycerine, on which children with measles respired during any of the eruptive days, exhibited numerous highly refractile bodies, larger than those seen in vaccine-lymph; others were elongated. They were most abundant in the two days of greatest eruption; they were not found in the breath during health, nor in the course of scarlet fever and typhus. After death from measles, on the eighth day, they were found in the true skin in groups below the rete mucosum, by the lymph-spaces and sweat-ducts, but not deeper than the level of these glands; sparkling, spindle-shaped, rod-like, or canoe-shaped bodies were also seen, which did not take the carmine stain. These bodies were not seen in the lymph-spaces, in the sweat-ducts and glands, nor in the hair-follicles. In the lung both forms were found in some exudation filling the alveoli. The spherical forms had a dark, smooth outline, and did not readily take the carmine stain. Near these were rod-like, fusiform, or ovate bodies, slightly stained by carmine. These are quite distinguishable from the particles seen in other forms of pneumonia. With a high power, similar sparkling, staff-shaped bodies were seen scattered round the bile-ducts. None were found in the kidneys, spleen, or mesenteric glands.

In the blood some increase of white and a great decrease of red corpuscles occurs during the fever of measles. Numerous moving microzymes have been seen during the eruption, decreasing rapidly, and disappearing in three weeks; but temporarily reappearing with any febrile disturbance.

Diagnosis.—The first spots of measles, if scattered, raised, and hard, may be mistaken for those of small-pox; or the small-pox eruption may begin with some measles-like roseola. The temperature curve for the two diseases is similar. In the small-pox curve a sudden rise begins only two days before the eruption, whilst in measles there is a gradual rise for three or four days; this in small-pox is evidenced by a history of sudden and severe illness only on the day but one before the eruption, whilst in measles there is no such symptom on that day, the illness dating from a day or two earlier, usually with distinctive catarrhal symptoms.

The declining rash of measles leaves a mottling of the skin, not unlike the mulberry eruption of typhus; the latter seldom appears before the fifth day of the disease, the fever continuing high for several days after. In measles, at this stage of the rash, the fever has already begun to decline, the temperature falling suddenly, often to below the normal. The rash of *rubeola sine catarrho*, *rubella*, or *Rötheln*, closely resembles the eruption of measles; the spots, brighter in colour and even more discrete, are preceded by only one day of headache or slight sore-throat. The incubation-period generally is longer than in measles. In scarlet fever the ingress is sudden; there is the characteristic sore-throat; and there is the early appearance on many parts of the body of the finely diffused, comparatively smooth, bright scarlet redness of the rash. The incubation-period has been short. In erysipelas the redness appears at one part only, and extends from that, whether it be the face or other parts of the body. Roseola from irritating articles of food has very little fever, and no enlargement of the cervical glands, otherwise it might look like measles; of the rashes from drugs that of phenazone may resemble the early papules, that from cubebs the later mottling. Urticaria and erythema, with differing aspect, cause but slight thermometric disturbance.

Prognosis.—This is mostly favourable in measles: the tendency of the febrile action is to recovery. Favourable progress may be endangered by—(1) the bad health of the sufferer; (2) want of care; (3) unsanitary surroundings. Under either of these conditions the simplest kind of measles may give rise to the worst forms of the disease. Morbilli *mitiores* and *graviores* are not essentially distinct. High fever with the eruption is not in itself unfavourable. At this time a temperature of 105° in children, and 104° in adults, or half a degree beyond, is safely reached; with precautions at its sudden decline, the progress afterwards is mostly satisfactory. High temperature during the

after-course is a sign of greater import; it guides to various complications, and subsides as they are relieved. Occurring irregularly it is a cause for anxiety; if steadily maintained, or recurring regularly at short intervals, with wasting as a result, there is little hope of recovery, and none if acute tuberculosis of lung or of brain is evidenced. The latter danger makes convulsions of worse augury in the decline than during the ingress of measles in young children; convulsions, taking the place of delirium in older persons, cease after the eruption. Recession of the rash is not alarming when the attack is slight, or the temperature is low at the crisis; when there is pulmonary or other local congestion, and at the same time sudden depression, it becomes an additional sign of danger. A dark rash, interspersed with fine red specks, may occur early in cases of moderate severity; a dusky or livid colour subsequently marks cases of considerable intensity; petechial or hæmorrhagic blotches at this time are of grave import, as indicative of scorbutus, which state ranks next to impaired nutrition in infants as the most unfavourable concomitant of measles. Black or hæmorrhagic measles, without scorbutus, is more rare than is hæmorrhagic or black small-pox. Some dangerous hæmorrhages may follow measles where no scorbutic condition exists. Among unsanitary conditions, though the presence of sewer-gas has in isolated instances determined a fatal result, the most disastrous is overcrowding. The great mortality from measles is due to lung-disease, not at the height of the fever, but in the second week; the frequency and severity of pulmonary complications being less a direct effect of low temperature than of tainted air in which the poor are pent up for the sake of warmth. During the ingress of measles exposure to cold may occasion a highly dangerous suffocative catarrh, with capillary bronchitis; after or during the rash a chill is as likely to conduce to serious diarrhœa as to pulmonary congestion, especially in hot weather. Equally depressing in their effects, these are direct results of the disease independently of weather or season. Measles contracted during acute or prolonged illness is a grave additional danger. In the puerperal state infinitely less mischief is produced by this disease than by scarlet fever. Delivery has been hastened without mischance; or abortion has resulted, not without risk of fatal results. There are times when young married women who have not had measles should keep from risk of infection. It would seem that the child can go through the disease *in utero*, with after-immunity. There is an instance on record of a mother with measles giving birth to a child 'full of measles,' both doing well; others of infants having the rash three, five, and eight days after birth, when the mother was herself ill. Infants escape measles while suckling, insomuch as they are less exposed to infection; they may suffer no less severely than others. In adolescence a body-heat of 107° has been safely passed, during the decline of measles, with no marked complication. In children of all ages a warning is given of some danger closely following the eruption when the normal fall of temperature at the crisis is delayed or prevented. In advanced convalescence sudden rise of temperature, with delirium, often marks an attack of pneumonia; this, if of limited extent, may be hoped to end favourably in a week by resolution, without much cough, but with steady high temperature till near the end.

Treatment. — Rest, pure air, equable warmth, diluents, and nourishment, are the chief requisites in the treatment of measles.

All risks from exposure or fatigue should be avoided while the disease may be only latent. The first catarrhal signs demand confinement to the room; the initial fever, rest in bed. The usual meals, moderate in quantity, may be taken; if not, milk, broth, or meat-jelly will be required. Extra liquids, such as barley-water, lemonade with gum or glycerine, cold water, and small pieces of ice, are pleasant and necessary. Simple salines, as potash in the lemonade, or citrate of ammonium, are useful. Dilute acetate of ammonium, coloured with syrup of saffron, is an old and good form; to this a few drops of ipecacuanha wine may be added, but neither expectorants nor diaphoretics have any influence on the cough until after the eruption. Antimonials and aconite should be avoided. The bowels must be gently regulated; a furred tongue is not a reason for giving purgative medicine. No diminution of the expected critical fever, if this were desirable, will be brought about by the action of emetics and aperients; where either of such evacuations have troubled the ingress, the eruption is delayed with no after-benefit. Hot applications relieve pain and cough. The free use of cold, so speedy and potent an antipyretic in scarlet and other fevers, is not required in the early stages of measles, and would be injurious until after the eruption is out; where this is interrupted, as by debility or chill, sometimes by convulsions in infants, the warm bath is to be used, with or without the addition of mustard. At this stage of the disease wine is rarely necessary; it may be required after epistaxis or for sudden depression, where food has not been taken. The room should be kept quiet, and at times dark, so that sleep may be favoured. Tepid sponging of the surface, part at a time, relieves the feeling of heat and tension; irritation is soothed by applying cold cream to the face, and carbolated oil to the body, or by rubbing with suet in some places. The bed-clothes should not be too heavy. An attendant may be required during the night. Good ventilation admits fresh

air without draught or chill to the patient. A spray of ozonised water or aromatic vinegar freshens the air of the room, and is preferable to steam. In this way, with previous good health, the danger of pulmonary complications is lessened. When several cases have to be treated in a ward, each patient should have a space screened off from draughts, and kept sweet. Directly the rash is out, the fever falls, the tongue cleans, the appetite returns, and the patient seems cheerful and well; ordinary food can soon be taken, sleep returns, and no alcoholic stimulant is required. On the other hand, with dislike of food, languor, or restlessness at nights, stimulants should be given, before the dry tongue, small and rapid pulse, receding rash, or signs of pulmonary congestion render free and frequent stimulation indispensable. There is, perhaps, no condition where wine and spirits produce such marked and immediate benefit as in the pulmonary congestion at the crisis of measles; they are sometimes a means of saving life in the after-depression till such nourishment can be taken as will soon supply the needed support. Sedatives are not often required; a small dose of Dover's powder moderates any tendency to diarrhœa; this is always to be guarded against and never provoked. Where, without complication, the febrile crisis is delayed, a dose of quinine with Dover's powder at night has been useful. After the crisis tepid bathing, with great precaution, aids sleep, and gives tone to the cutaneous, bronchial, and pulmonary circulations; cold affusions may be necessary for hyperpyrexia at a later stage, when, if head-symptoms threaten, ice should be applied to the head. Croupy symptoms and bronchial catarrh are better treated without steam cots or kettles. Diarrhœa at the close of measles may take the place of pneumonic symptoms, and need not be suddenly checked; rest in bed, carefully regulated diet, and stimulants, with opiate epithems, or an opiate enema, will relieve this. The mineral acids, with or without a bitter, aid digestion, and can either be given very dilute as a drink at any time, or in a definite dose with food. For the irregular febrile disturbance noticed in the weakly, they are useful adjuncts to the quinine or cod-liver oil that are then essential. Some local troubles must be treated. Earache needs a dose of butyl-chloral hydrate, or a warm poultice with a little opium in the ear gives relief; otorrhœa requires tepid syringing. For ophthalmia, lead lotion, and the topical use of belladonna or atropine if there be photophobia, are necessary; the swollen eyelids should be raised to see that no injury to the eye occurs, while other severe symptoms may be attracting most attention. Ulcers in the mouth or elsewhere may have to be touched with diluted borax or boric acid, where astringent washes are ineffective. After-treatment is always important and necessary. For the anæmia which attends convalescence some form of iron is to be taken with meals two or three times a day. Cod-liver oil should be given an hour after meals, at least twice a day, to the strumous or delicate. Often the mineral acids with a bitter are of service, especially when the rash has been livid or petechial. The clothing should be warm, with flannel next the skin. Cold bathing rapidly performed, or with salt-water, is to be recommended; and when the weather is fine, the patient should go out of doors once or twice a day, avoiding chill or fatigue. Children are the better for an afternoon sleep; adults should avoid full work, or exposure at night, for one or two months after measles. Convalescents should have a change of room in the second week of the illness. Means should then be taken to purify and disinfect the sick chamber, as by burning sulphur or the bisulphide of carbon in it before the cleaning; this does not interfere with other rooms in the house to which convalescents are removed. All clothes and the bedding used during the illness should be afterwards stoved. Change of air or place is not so necessary as is often supposed. Home is the best place for cure, not only until all danger of infection is passed, but that the dangers of convalescence and the possible development of any constitutional defect may be watched, and receive the earliest and best attention.

William Squire.

MEASUREMENT.—A method of physical examination, in which tape-measures and other instruments are used to ascertain accurately the shape, dimensions, and movements of different parts of the body. *See* Physical Examination.

MEDIASTINUM, Diseases of.—Synon.: Fr. *Maladies du Médiastin*; Ger. *Krankheiten des Mediastinum.*—The principal morbid conditions which occur in connexion with that region of the chest which is known as the mediastinum, are (1) aneurysm of the thoracic aorta; (2) inflammation of the tissues or textures within the cavity; and (3) new-growths involving the same space. Of these conditions, aortic aneurysm is by far the most common; but it possesses so many special features that it is described separately in this work (*see* Aorta, Diseases of; and Thoracic Aneurysm). The remaining pathological conditions involving the mediastinum are discussed in this article.

1. Mediastinum, Inflammation of.—Synon.: Mediastinitis; Fr. *Médiastinite*; Ger. *Mediastinitis.*

Definition.—This term has been employed to denote inflammation of the serous surface of the duplicature of the pleura separating the pleural from the mediastinal cavity, and also inflammation originating in the cellular tissue or other textures of the mediastinal

space. In the former sense mediastinitis is but a variety of pleurisy, which, though it may be characterised by special symptoms, must be very difficult, if not impossible, to diagnose during life. We confine our attention here to inflammation and its results in the mediastinal cavity.

Ætiology and Anatomical Characters.—There are very few trustworthy observations on record of simple acute inflammation of the mediastinum, terminating either in resolution or in effusion of plastic lymph. An example of the latter detailed by Wildemann is probably unique. In this instance the anterior mediastinum was filled with layers of solid exudation; the pericardium inflamed; and its cavity distended by six ounces of pus. The mediastinal effusion appeared to have been occasioned by long-continued pressure on the sternal region. On the other hand, we have numerous examples recorded, in which mediastinal abscesses have resulted both from primary or idiopathic, and from secondary or symptomatic, inflammation. Primary abscess, though rare, is occasionally met with, produced either by local injury or simply cold. Gunther (in *Oesterreich. Zeitschr. f. prakt. Heilk.* 1859) and others have recorded cases of mediastinal abscess originating simply in cold. It may, however, be suspected that some forgotten physical injury had in certain of these cases been received, as in the only case of the kind that has fallen under the writer's notice. Dr. Goodhart, in the *Pathological Transactions*, vol. xxviii., records a case of acute mediastinal abscess, resulting apparently from injury produced by the sticking of a piece of meat in the œsophagus. But by far the most frequent cause is suppuration of the lymphatic glands in scrofulous subjects, as in a remarkable instance recorded by Dr. Bristowe, in the *Pathological Transactions*, vol. ix. p. 46. Secondary or symptomatic abscesses, in the form of purulent *dépôts*, are not infrequently met with in the anterior mediastinum, either in connexion with operations, such as tracheotomy, or as the result of general pyæmia. Syphilitic gummata are also sometimes found in this region.

Symptoms.—The only instance of primary abscess of the anterior mediastinum that has fallen under the writer's observation presented the following symptoms: A middle-aged lady, previously in good health, fell on going upstairs and struck the sternum against the stone edge of the stairs. A few weeks afterwards she complained of uneasiness about the chest, and of pains in the left shoulder and about the scapula and neck. They were not severe, and had more the character of neuralgia or rheumatism than of anything more serious. After a time there was some general derangement of the health, attended by dyspeptic symptoms, a certain degree of febrile disturbance, some dyspnœa, and inability to lie down except in certain positions. Two months after the accident, which had been forgotten, there was a distinct prominence over the upper part of the sternum of an oval shape, and rather less in circumference than the palm of the hand, not red, but tender on pressure, and to which was referred a sense of uneasiness and oppression. The aspect of the patient was indicative of some anxiety, but not distress. The breathing was quiet; the pulse was quickened; but there was little or no febrile heat. There was some cough, attended by mucous expectoration sometimes streaked with blood. The patient complained of soreness and irritation of the larynx and fauces. The action and situation of the heart were normal. There was dulness on percussion over the whole of the prominence of the sternum, and nowhere else throughout the chest, but neither pulsation nor fluctuation could be detected in the swelling. There was no physical evidence of pressure either on the trachea or bronchi, although the patient admitted a feeling of weight or pressure, as well as of dull uneasiness; but there had been no sense of throbbing. There was no enlargement of the jugulars or superficial veins, nor any tumefaction of the base of the neck. Careful physical examination of the whole chest revealed nothing beyond a few loose mucous *râles*. Local sedative applications and the use of bromide of potassium gave some relief to the pain and local tenderness, but the cough and laryngeal irritation continued. After a few days about a teaspoonful of bright fluid blood was coughed up, and the day following a little more without effort. The next day there was suddenly brought up from two to three ounces of purulent matter, followed by a sense of great relief. A microscopical examination of this matter revealed nothing more than pus and mucus mixed with an unusually large number of squamous epithelial cells, but not a trace of elastic tissue, or anything to indicate disorganising changes in the lung. The purulent expectoration continued, but in steadily decreasing amount, for about five weeks, the sternal swelling subsiding *pari passu*. Ultimately the sternal region was of normal aspect, and the general health was completely restored, though for some time there was occasional slight oppression of the breathing.

The above example has been recited because the symptoms correspond very closely with those which have generally characterised such cases. In some instances, however, there has been more distinct evidence of phlegmon, and a greater amount of febrile disturbance and distress. Unless the abscess be large, or associated with glandular or other organic disease, symptoms of compression, either of the bronchi or large vessels, are not usually observed. But in the latter case there may be not only symptoms of venous and

bronchial obstruction, but even serious laryngeal symptoms and paroxysms of severe dyspnœa. The abscess may open into either the trachea, bronchi, or pleural cavity, if no external outlet is obtained. Spontaneous external opening is said to occur most frequently on a level with the second rib, to the left of the sternum.

Prognosis.—The prognosis of mediastinal inflammation should, in view of its possible modes of termination, be guarded.

Treatment.—Unless the acute symptoms of phlegmonous inflammation should be well marked, but little can be done in the way of treatment, beyond allaying pain, and the use of local soothing applications. Strict rest should be enjoined, and an external opening should be made for the outlet of matter as soon as distinct indications are presented of its presence. It should also be borne in mind that the inflammatory action is liable to spread, and to involve either the lungs or the pericardium.

2. **Mediastinum, Morbid Growths connected with.**—By far the larger proportion of intra-thoracic growths originate in the mediastinum, and for the most part in the lymphatic glands. Others, which may commence in the lungs or pleura, involve, sooner or later, the mediastinal spaces. In treating, therefore, of mediastinal tumours, from a clinical point of view, it is of less importance to determine their precise origin than to ascertain the general character of the growth, its modes of development, and the effects likely to be produced on the surrounding textures. It is manifest, however, that the particular site of the growth must exercise an important influence, both on the early symptoms and the subsequent features of the case. It is important, therefore, to remember, when forming a diagnosis in cases necessarily very obscure in their early stages, how very various are the situations and relations of the growths. Thus either functional derangements of the heart, neuralgic pains of the muscles, dysphagia, spasmodic affections of the larynx, bronchial irritation, or limited pleuritic symptoms, may be the earliest indications.

Varieties and Symptoms.—Almost every form of morbid growth has been met with in the mediastina: cancer in all its varieties; sarcomatous, osteosarcomatous, enchondromatous, and fibrous tumours; lymphadenoma; lardaceous, steatomatous, and tubercular masses; and syphilitic gummata. The progress and duration of the case will differ materially, according to the natural history of these several formations. The growth of some is much more rapid than that of others. By some the adjacent textures are much more readily invaded than by others. Constitutional symptoms and impairment of the general health are much more pronounced in some than in others. Apart, therefore, from the special features given to each case by the particular locality of the disease, there will be very great differences in its general aspect and progress. And were it only in reference to prognosis, irrespective of treatment, it would be very desirable to determine the nature as well as the existence of the growth. This, unfortunately, in many instances, cannot be done; but in others we may form an opinion with considerable confidence. The development of the malignant growths is generally much more rapid than that of the more innocent, and the duration much shorter. It is seldom that the duration of intra-thoracic growths of a malignant character extends beyond a year. Those having the character of lymphadenoma or lymphosarcoma are sometimes of much longer duration. These in a large proportion of cases commence in the lymphatic glands of the posterior mediastinum, or in the anterior mediastinum, from, as some believe, remains of the thymus gland. They sometimes attain to an enormous size, and may ultimately involve all the structures within the thorax, including the heart and pericardium. In other instances, commencing probably in the connective tissue, the disease spreads along the roots of the lungs and sides of the bronchi, extensively involving the adjacent tissues and the lungs themselves, without, for a long time, giving rise to any considerable tumour. In other cases several distinct tumours are developed at some distance apart. The period at which pleuritic effusion or œdema of the external parts occurs also varies greatly. Thus, too, it happens that alterations in the external form of the chest are early manifest in some cases, and not till later in others. In some instances these alterations of form are limited, in others they implicate the whole of one side, or even the whole contour of the thorax. In not a few instances, whilst the growth is still of limited extent, and confined to the posterior mediastinum, the symptoms so closely resemble those of aneurysm as to make the diagnosis extremely difficult and uncertain. The more prominent symptoms are indeed in some instances, and for a long time, mainly cardiac. This it is important to bear in mind, inasmuch as pericardial effusion and consequent sternal prominence has been mistaken for a mediastinal growth. In the most malignant types of disease, and where, as in far the greater number of instances is the case, the lymphatic glands of the thorax have become implicated by extension of disease from other organs, the local thoracic symptoms are from the first associated with those general symptoms which are characteristic of malignant disease, and pass under the term of cancerous cachexia. Sarcomatous tumours, on the other hand, may attain a considerable size without constitutional symptoms of any special character. As a rule it

may be said that all intra-thoracic growths tend to develop inwards rather than outwards; and thus often overlap the lungs and heart, pass along the great vessels and nerves, and press on those parts which offer least resistance. It is only in very rare instances that the chest-walls become eroded by the outward pressure of the tumour, as happens in so many cases of aneurysm. This is the more remarkable because in many instances the presence of the growth is distinctly indicated by external tumour, arising from outward pressure of portions of the chest-walls. This is of course especially the case when the growth is in immediate proximity to the walls of the chest. In the case of large tumours the external form of the chest may be rendered unsymmetrical by displacement of the heart, and downward pressure on the diaphragm and liver. There is, however, another and very distinct mode by which the symmetry of the chest is affected, and that is by collapse of the lung and sinking of the chest-wall, in consequence of the pressure exercised on the root of the lung by the progressive advance of the tumour. The effect of this is sometimes rendered still more apparent by the corresponding expansion of the opposite lung, either from congestion or induced emphysema. The deformity of the chest attains its maximum in many cases by the outgrowth of tumours above the clavicle and along the neck. It may be well, however, at the risk of some repetition, to classify, under different heads, the most characteristic of the multifarious phenomena that have been observed in connexion with the different varieties of mediastinal growths.

Derangements of the circulation.—Derangements of the circulation, which are necessarily induced, in all cases, to a greater or less degree, give rise to phenomena which are of special diagnostic importance in mediastinal tumours. The return of blood through the vena cava superior and its affluents is early impeded, more or less, in the majority of cases, and sometimes to such an extent as to give a special aspect to the case. It is not, however, simply by pressure on the venous trunks that the indications of pulmonary congestion, œdema, and cyanosis are induced. In many cases the veins themselves, although seldom the arteries, are involved in the cancerous disease; and when this is not the case, there is often a special tendency to thrombosis and obliteration both of the large veins and of their radicles. Cancerous deposit has, in some cases, been traced into the jugular and subclavian veins, entirely occluding them; in other cases these vessels have been enormously distended. Thus we have in many instances great tumefaction of the face, neck, and upper extremities, from œdema and general serous infiltration. In like manner, obstruction to the circulation through certain portions of the lungs may give rise either to hæmorrhage in the form of hæmoptysis, to sanguineous effusion into the pleura, or to large apoplectic clots, that is, infarcts. In this latter way the physical signs of consolidation are sometimes suddenly induced, or increased; and after death the pleural cavity has been found occupied by large protuberances from the pleura, consisting simply of blood-tumours, due to extravasation into the pulmonary tissues. Although the arteries are much less liable to become implicated in cancerous disease than the veins, they are subject, like all the other contents of the thorax, to pressure. The force of the current of blood through them may thus be diminished, and there may be a marked difference in the radial and carotid arteries of the two sides, just as there is in aneurysm of the aorta. It is needless to say that the symptoms arising from mechanical influences acting on the heart must be very various. This organ may either be dragged from its natural situation, or surrounded, more or less completely, by the advancing disease, and its situation and action concealed from all observation; or its very substance may become involved in the spread of the disease, and the pericardium may be largely distended by serous and bloody effusion. Apart from those disturbances of the heart's action arising from interrupted circulation through the lungs, its innervation may be seriously affected, as will be subsequently noted. And it is evident that the sounds, rhythm, and impulse will be affected in more ways than one; even when neither the valvular apparatus nor any other structure is the actual seat of disease. In the malignant forms of disease the muscular power of the heart is generally impaired, and there is a consequent tendency to palpitation and faintness, often associated with nausea and vomiting. Such symptoms have been observed in rare cases, where the heart has become implicated by disease extending from the mamma through the thoracic walls.

Febrile symptoms.—Mediastinal tumours are not as a rule characterised by febrile disturbance, at any period of their course. Several examples of tumours having the character of lymphadenoma have, however, exhibited striking exceptions to this rule. The writer has recorded a remarkable instance, and others have been recorded by the late Dr. Murchison and Dr. Church, in which there was persistent elevation of temperature, and rapidity of pulse and respiration, but with daily alternations of rise and fall. And in these instances it is remarkable that the pyrexia declined with the advance of the disease to its fatal termination. Intercurrent inflammatory affections, whether of the pulmonary tissue or of the pleura, may in any case occasion corresponding symptoms of fever. These, however, are seldom very pronounced.

Disturbances of innervation.—Disturbances of innervation occur at all stages, and in connexion with every variety of growth. They vary, however, greatly in their character and severity. Although pain may be said to be present in most instances, it is often, all through the case, by no means a prominent symptom. The patient's distress, often very great, is more frequently due to dyspnœa and interrupted circulation than to direct implication of the nerves. Nevertheless neuralgic pains are among the most frequent of the early subjective symptoms, and are sometimes severe in the later stages. When from the situation of the growth the recurrent laryngeal nerve is early implicated, we sometimes get paralysis of the vocal cords, and aphonia, at other times spasmodic paroxysms of dyspnœa and urgent laryngeal symptoms. In rare cases cancerous disease of the posterior mediastinum has invaded the spine, and given rise to paralysis of the limbs and trunk (*vide* Cases 11 and 12 in the writer's *Lumleian Lectures*). The cough, which is generally due to more or less bronchial irritation and secretion, sometimes arises from purely nervous reflex irritation, and may occur in paroxysms like those of whooping-cough. The innervation of the heart may be so disturbed as to occasion symptoms of angina, as well as various irregularities of action and tendency to fainting. The immediate cause of death is not infrequently to be attributed to sudden interruption of the heart's action.

Respiratory phenomena.—The respiratory phenomena, although presenting the utmost diversities, have nevertheless certain special characteristics. When the patient is at rest, there is often nothing to denote any impediment to the respiratory function — no quickened movement, no alteration of aspect, no expression of anxiety; but on the least exertion, dyspnœa is at once manifested. Mere change of position may induce a paroxysm of dyspnœa. With advancing disease implicating at length the contents of the thorax to a great extent, there may be no corresponding increase of dyspnœa, especially if the progress be slow. In other cases, with physical signs of a very questionable and limited character, there may be great distress in breathing. Absence of apparent dyspnœa is sometimes the more remarkable from the manifestly diminished movement of the chest-walls, or even complete immobility perhaps of one side. Nor in many cases does the dyspnœa correspond with the evidence of pressure, and the absence of respiratory sounds on auscultation. The want of correspondence between the physical signs and the functional symptoms is indeed often most striking. In one case there will be persistent difficulty of breathing, amounting to orthopnœa of the most urgent character, in another merely a little quickened respiration—lividity and turgescence of features in one case, in another an anæmic aspect.

Physical signs.—So long as a mediastinal tumour remains of but small size, it will, of course, not be recognisable by external physical signs, except such as are due to mechanical derangements of the circulation, generally denoted by enlargement of the external superficial veins. Comparatively small tumours will, however, sometimes manifest themselves by circumscribed alterations in the external aspect of the chest. This of course will depend much on the site of the tumour. Tumours of the anterior mediastinum may very early manifest themselves, by throwing forward the sternum and the sternal attachments of one or more of the ribs, and ultimately rendering the two sides of the chest asymmetrical. It is in these cases, when, with the growth of the tumour, the heart and aorta become overlapped and pressed on, that we have evidence of pulsation and vibration, simulating closely the signs of aneurysm, and sometimes attended by a cardiac bruit. In other cases the growth, extending upwards, shows itself by tumefaction and swelling above the sternum and clavicles, being then often attended by signs of pressure on the trachea or bronchi. When the posterior mediastinum is the chief seat of disease, this may attain to very considerable development before any very decided alteration is seen in the form of the chest, unless one or other pleura have become distended by fluid effusion. The diagnosis of these latter cases often presents the utmost difficulty, the physical signs being simply those of pleuritic effusion, and the symptoms such only as may be fairly referred to the mechanical effects of fluid pressure. When the tumour is of any considerable size, the motions of those parts of the chest-walls which are in immediate proximity to the growth are almost always impeded, and there is evidence of diminished expansion. This is also the case when the pleura is occupied by secondary growths, when there may be obliteration of the intercostal spaces, as in pleurisy. But as collapse of the lung sometimes takes place with little or no pleuritic effusion, there may be falling in of one side of the chest, appreciable by the eye, as well as by measurement. As, however, the tumour usually extends more to one side than the other, the measurements of the two sides will generally differ, from this cause alone. By percussion and palpation the ordinary signs of solidification will of course be detected, whenever the tumour approaches the chest-walls and attains to any size, or whenever any considerable portion of the lung has been rendered solid, either by invasion of the growth, by pneumonic consolidation, or by hæmoptyic engorgement. Signs of displacement are often manifest comparatively early, and later on may be of the most

unmistakable character. The heart may be dragged away from its natural situation in various directions; the diaphragm thrust down; the lower ribs thrown out; and the deformity of the anterior part of the chest, and the physical signs on auscultation and percussion, may be greatly modified, by distension of the pericardium from effusion. It will at once, therefore, be seen that the cardiac signs will be of very variable and diverse character—so much so that any detailed description would be of little practical use. It should also always be remembered that the lung undergoes very various and opposite changes as the result simply of pressure on the bronchi, and interruption to the entrance and egress of air from the air-cells. Thus in the early stages there may be more or less of emphysema, and corresponding physical signs on the affected side; and in more advanced cases a certain amount of emphysema of the opposite side. As the bronchi become occluded, we have at first the stethoscopic signs of accumulation of secretion, soon to be followed by signs of consolidation and absence of respiration, when the lung is undergoing those destructive changes by which it becomes converted into a solid mass broken up by irregular abscesses or pockets of pus, produced in part by actual pulmonary disintegration, and partly by dilatation of the bronchi. In the latter condition there may be enlargement of the lung and distension of the side, rather than collapse. Hyper-resonance from emphysema, followed by signs of consolidation and absence of all respiratory phenomena, associated with or preceded by other indications of pressure, would be tolerably decisive of the existence of a mediastinal tumour, but whether aneurysmal or some form of malignant disease might still be a question.

Diagnosis.—From the preceding remarks it will be evident that there are no symptoms or physical signs, nor any precise order of phenomena, that can be said to be peculiar to, or diagnostic of, an intra-thoracic growth. No two cases will be found to be precisely alike. Nevertheless, the want of correspondence with the ordinary forms of thoracic disease; the very general presence of signs of pressure and mechanical derangement; and the varying aspects of these signs, are, in the majority of cases, when considered in conjunction with the history of the case, sufficient to lead, if not to a positive, at least to a highly probable, diagnosis. In the early stages of a mediastinal tumour, when the growth is still small, it will be easily seen, if we reflect on the anatomical relations of the mediastinum, that an accurate diagnosis must often be impossible. And even when formidable symptoms arise from the peculiar relations of a small growth, it must often be extremely difficult to avoid error. Both retro- and antero-sternal nodes will sometimes closely resemble both aneurysm on the one side, and mediastinal tumours on the other. For further observations the reader is referred to the articles Bronchial Glands, Diseases of; Lungs, Malignant Disease of; and Thoracic Aneurysm. *See* also 1. Mediastinum, Inflammation of.

Treatment.—There is but little that can be said as to the treatment of mediastinal tumours, except as regards the palliation of urgent symptoms, or the relief of some of the chief secondary effects of the original disease. All forms of intra-thoracic growth of a malignant character are steadily progressive to their fatal termination. Some of the less malignant in character—for example, lymphadenomatous tumours—may last a long time, and appear for a while to be stationary, and unattended by any serious impairment of the general health. Even these, however, are exceptional cases. Bodily rest, freedom from causes of moral disturbance, maintenance of the general nutrition, change of air, and every available hygienic means, are essential in all cases. Chalybeates and other tonics may be of more or less service. Iodide of potassium has appeared to be of use in some cases, and mercury has been recommended. Special symptoms often admit of considerable relief; for instance, local pains by external soothing applications, or by counter-irritants, such as sinapisms and small blisters. The latter are often of signal benefit. Pain, sleeplessness, and harassing unrelieving cough may all be alleviated by opium and other narcotics or sedatives, such as chloral or bromide of potassium, and sometimes by minute doses of antimony. For the distressing paroxysmal attacks of dyspnœa and laryngeal spasm, opium and its preparations require to be given with caution; but chlorodyne, Hoffman's anodyne, and the inhalation of chloroform are often useful. The distress arising from dyspnœa and inability to lie down will often tax the resources of the physician to the utmost, depending as they do on a variety of complex causes. When they appear to be mainly referable to accumulation of fluid in the pleura, paracentesis must be resorted to, and will often be followed by great temporary relief. At one time the writer was averse to this procedure, but further experience has led him to believe that it is productive of little if any mischief, and that life may sometimes be much prolonged by even repeated evacuation of the pleural effusion. In proportion as symptoms of pleurisy, bronchitis, or pneumonia predominate, they must be met by the ordinary therapeutic resources. It remains to be seen whether our further knowledge of the natural history of lymphadenoma may advance our therapeutic resources. Certainly the slower progress of such cases affords more time for the trial of iodine, chalybeates, or other constitutional remedies.

It should ever be borne in mind that severe attacks of dyspnœa, with stridulous breathing and other indications of intra-thoracic pressure, may all be due to nerve-irritation alone, and often be greatly alleviated by small doses of morphine combined with antispasmodics. J. RISDON BENNETT.

MEDIATE (*medius*, intervening).—A term applied to auscultation and percussion, when some medium is interposed between the surface of the body of the patient and the ear or finger of the physician, such as the stethoscope in the one case, or a pleximeter in the other. *See* PHYSICAL EXAMINATION.

MEDITERRANEAN, The.—A moderately dry, warm, and very sunny winter climate. *See* ALGIERS; CANNES; HYÈRES; MALAGA; MENTONE; NICE; SAN REMO, &c.; and CLIMATE, Treatment of Disease by.

MEDULLA OBLONGATA, Lesions of.—SYNON.: Fr. *Maladies de la Moelle Allongée*; Ger. *Krankheiten des verlängerten Marks.*

INTRODUCTION.—The pathology of the medulla oblongata is more than usually complex. Not merely is it liable to injuries, and diseases such as hæmorrhages, softenings—necrobiotic and inflammatory, tumours, &c., having their primary seat there, as in other nerve-centres; but also, and more frequently, the medulla is implicated in diseases of the pons and cerebellum, and affected indirectly by intracranial diseases in general. Being the connecting link between the brain and spinal cord, it is subject to ascending or descending degenerative processes, secondary to lesions in the spinal or cerebral sensory and motor tracts. Further, it is the seat of a special form of degeneration, characterised by a very definite group of symptoms, differentiated under the term 'bulbar or labio-glosso-laryngeal paralysis.'

With the indirect affections of the medulla oblongata, in connexion with the various forms of intracranial disease, degenerations of the motor or sensory tracts secondary to cerebral or spinal disease, or the pathology and symptomatology of bulbar paralysis, this article does not profess to deal, as these subjects will be found fully discussed under other headings. Attention will be directed mainly to the data which serve to establish, so far as this is possible, the regional diagnosis of medullary lesions.

SUMMARY OF PATHOLOGICAL CONDITIONS.—*Traumatic lesions.*—Injuries of the medulla oblongata are not uncommon in consequence of fracture or dislocation of the atlas and axis, as in falls, hanging, twisting of the neck, or as the result of diseased vertebræ. In such cases death is instantaneous, owing to the sudden cessation of the circulation and respiration, from lesion of the centres of these vital functions, which are situated in the medulla (Flourons' *nœud vital*).

To commotion or contusion, with punctiform extravasations in the medullary centres (Duret, *Sur les Traumatismes Cérébraux*, 1878), is also to be attributed sudden death from blows on the head. Not infrequently lesions of the fourth ventricle, the result of cranial injuries, not proving fatal, give rise to diabetes mellitus or insipidus, along with other symptoms indicative of chronic lesion of the pons or medulla.

Effusions of blood into the fourth ventricle, whether arising from the medulla itself, the pons, or the cerebellum, or gaining access from the lateral ventricles by the aqueduct of Sylvius, are, as a rule, suddenly fatal from paralysis of the circulation and respiration. Death may occur with or without convulsions.

Tumours.—Tumours implicating the medulla oblongata may have their seat primarily in the medulla; but more commonly the tumours are situated at the base of the skull, in the cerebellum or pons, and invade the medulla in their growth. Apart from the general symptoms of cerebral tumour—headache, sickness, optic neuritis, &c., the special indications of implication of the medulla oblongata are one or more of the symptoms mentioned below. Here also, however, some remarkable cases have been put on record, in which, notwithstanding the existence of tumours actually in the substance of the medulla itself, the symptoms during life have presented nothing striking or characteristic. (*See* a case by Dr. Wilks, *Diseases of the Nervous System*, 1878.)

Hæmorrhage.—Hæmorrhage into the substance of the medulla oblongata, and limited to this, is comparatively rare. More commonly the pons and medulla are affected together. Hæmorrhages here of any extent are very rapidly fatal. In some cases death is instantaneous. In others a few hours may elapse, death occurring in profound coma with stertorous respiration and occasionally convulsions. Whether the hæmorrhage is primarily in the medulla or in the pons cannot be diagnosed with certainty. The other causes of sudden death, such as affections of the heart, must be excluded before hæmorrhage into the medulla can be diagnosed, and this is in many circumstances obviously impossible.

Hæmorrhage into the medulla oblongata is usually fatal, and rarely gives rise to chronic stationary lesions. These are commonly the result of thrombosis or embolism, or, more rarely, acute myelitis.

Thrombosis.—Thrombosis of the vertebral arteries is the most common origin of softening limited to the medulla oblongata. The onset is frequently sudden, as in hæmorrhage, but the course is more slow. The more chronic nature of the affection is an important diagnostic feature of softening. The

symptoms of softening of the medulla thus arising are in many respects like those of progressive bulbar paralysis, but there are also important differences. They are sometimes generalised under the head of 'acute' or 'apoplectiform' bulbar paralysis, in contradistinction to the classic form of this affection described by Duchenne. *See* LABIO-GLOSSO-LARYNGEAL PARALYSIS.

LOCALISING PHENOMENA.—The symptoms met with in the affection just named are the most reliable clinical data on which to found a regional diagnosis of lesions of the medulla oblongata. The characteristic symptoms are a conjoint affection of the extremities and one or more of the bulbar cranial nerves, with impairment of speech and deglutition, and cardio-respiratory disturbances. Sometimes all four extremities are paretic or paralysed; sometimes the lower extremities alone; and occasionally the paralysis is of the hemiplegic order. If the paralysis affects only the extremities, without implication of the bulbar nerves, as sometimes occurs, a diagnosis of the medullary seat of the lesion cannot be made with certainty. Anæsthesia has not been recorded, but occasionally paræsthesiæ have been observed. Ataxic affections of the extremities have also been met with by Leyden and Prévost.

Of the cranial nerves the hypoglossal is most commonly involved. The symptoms are impaired mobility of the tongue, with more or less pronounced dysarthria (*see* APHASIA). This is not absolutely characteristic of bulbar disease, however, as a similar affection of the hypoglossal may occur in disease of the pons. The tongue and speech are rarely, if ever, so affected as in the classic or progressive bulbar paralysis, nor has the atrophy of the muscles of the tongue, with altered electrical reactions, been noted.

Of more importance as a diagnostic mark is dysphagia, or paralysis of deglutition. This, in the absence of general cerebral symptoms, points to affection of the medulla. Paralysis of the soft palate, on one or both sides, is also a frequent, if not constant, symptom. Occasionally also aphonia occurs, and, taken with the other symptoms, points conclusively to affection of the medulla oblongata.

Irregularity of the heart; acceleration or retardation of the pulse; and sighing and laboured respiration, often amounting to orthopnœa, in the absence of general cerebral symptoms, are also important indications of disease of the medulla oblongata. Among other symptoms have been noted coughing and vomiting, explicable by affection of the respiratory centres. Trismus has been mentioned by Joffroy as a characteristic symptom of acute bulbar paralysis, but Nothnagel, on good grounds, disputes the accuracy of this statement.

A case recorded by Glynn, *Liverpool Med. Chir. Journ.* 1887, where a tiny tumour (glioma) was found *post mortem* in the middle line of the medulla at the level of the calamus scriptorius, showed many of the above-mentioned symptoms, the most prominent being intense dyspnœa with paralysis of the diaphragm, vomiting, impaired movement of lips and tongue, dysphagia, loss of reflex action of palate, weakness in both arms and less in legs, and a trace of sugar in the urine.

Albuminuria and glycosuria have also been observed in connexion with bulbar lesions, the latter more particularly after injuries affecting the floor of the fourth ventricle; but the occurrence of these symptoms in connexion with acute bulbar paralysis requires further investigation, as they cannot as yet be regarded as constant.

An affection simulating disease of the medulla oblongata results from bilateral lesion of the anterior third of the internal capsule (Lépine), or of the cortex in the region of the lower extremity of the ascending frontal and posterior extremity of the third frontal convolution (Barlow). Such a bilateral lesion causes paralysis of articulation, and also true aphasia if the lesion is cortical, along with a greater or less degree of double hemiplegia. The diagnosis must depend on the truly volitional character of the paralysis in such cases, the reflex mechanism of deglutition being unimpaired. There will also be absence of affection of sensibility and of trophic degeneration of the muscles, and absence also of disturbances of the cardiac and respiratory rhythm. Defective comprehension of speech, and obvious aphasia—the movements of articulation not being absolutely paralysed, and also agraphia—the hand not being completely powerless, will differentiate cerebral from bulbar paralysis. D. FERRIER.

MEDULLA OF BONES, Diseases of.—SYNON.: Fr. *Maladies de la Moelle des Os*; Ger. *Krankheiten des Knochenmarks.*—The morbid conditions of the medulla of bones are most conveniently described under the head of the several diseases of which they almost invariably form but a part. Thus, injuries, acute and chronic inflammation or osteomyelitis, and the majority of new-growths involving the marrow, affect the bone as a whole, and are accordingly discussed in the article upon these subjects (*see* BONE, Diseases of). Myeloid tumour, which is peculiarly connected with the medulla, is also described and figured in the article on TUMOURS.

The medulla of bones is also the seat of important pathological changes in several chronic constitutional diseases. For instance, it is affected in some cases of leucocythæmia, and of lymphadenoma; in mollities ossium; and in rickets. The reader is referred to the description of the anatomical characters of these conditions in the articles bearing their several names.

MEDULLA SPINALIS, Diseases of.—*See* SPINAL CORD, Diseases of.

MEDULLARY CANCER.—A synonym for encephaloid cancer. *See* CANCER.

MEGRIM. — SYNON.: Migraine; Sick Headache; Nervous Headache; Hemicrania (ἡμι, on one side of; and κράνιον, the head); Fr. *Migraine*; Ger. *Migräne.*

DEFINITION. — Headache of a periodical character; generally ushered in by some premonitory symptoms; more or less unilateral; and frequently associated with nausea and bilious vomiting.

ÆTIOLOGY.—The chief predisposing causes of attacks of migraine are hereditary tendency; anæmia; a general want of tone in the system; and the nervous temperament. Among the exciting causes may be included all those of a depressing or exhausting nature, whether physical or mental, such as prolonged mental work, mental excitement, grief, anxiety, bodily fatigue, late hours, sexual excesses, breathing the impure air of a crowded room, and improper food.

SYMPTOMS.—This complaint seems to have two more or less well-defined stages, the headache being preceded for a variable period by certain disorders of sensation. In some persons the malady stops short here, and is not followed by headache; in others the headache appears to be developed without any premonitory symptoms, until careful inquiry reveals the contrary. The two stages therefore are, first, the stage of disordered sensation; second, the stage of headache, with other symptoms.

The most striking of the disordered sensations is a transient disturbance of vision which sometimes takes place. It commences with a wavy glimmering near the outside corner of the field of vision, and spreads all over the visual area with a zigzag outline, in a straight-lined angular pattern, and with or without lines of colour between the darker lines. Or it may commence by the appearance of a blind spot close to the centre of vision, which soon begins to spread, showing a serrated margin, and presenting a tremor or wavy glimmering in its interior. This condition is often associated with a feeling of chilliness, coldness of the hands and feet, or other symptoms; it may last from five to thirty minutes or longer, and then be succeeded by the stage of headache.

On the other hand, the headache may be, and in many individuals always is, developed without the ocular disturbance, but other sensations are substituted for it. The patient has a feeling of chilliness, and the feet are cold. There is mental depression, with a dread of impending evil; the patient is restless and uneasy; 'cannot quite tell,' as he says, 'what he would be at;' and has what is expressively called 'the fidgets.' This condition may continue half an hour or more, and then the slight boring piercing pain is felt in the head, with which the aching begins; and the disorder runs its course, as will be presently described. In other cases, this feeling of depression or uneasiness lasts for several hours, the patient goes to bed, and in the early morning wakes with the headache fully developed.

The headache, when preceded by ocular disturbance, shows itself as follows: When the vibratory movement is at its height, a little aching is felt in the head, on the side *opposite* to that on which the glimmering first appeared; it is slight at first, but gradually increases in intensity. Some persons have said that the sensation was as though a point in the temple were being bored with a gimlet, and the gimlet slowly increasing in size. The pain gradually spreads from this point, which may be covered with the finger, and pressure upon which affords relief, first over one side of the head; and then, but not always, it extends to the other. As the headache increases, the ocular disturbance declines; nausea is felt, which increases with the headache; retching and vomiting occur, the latter sometimes, though rarely, giving relief; the head throbs; the slightest movement increases the pain, and any attempt to move from the recumbent posture increases the gastric uneasiness; the mouth feels clammy; the eyeballs ache, and are tender on pressure, one more so than the other; the pupils are rather contracted, and generally unequally so; and the patient lies apparently more dead than alive, his face pale, and the head hot. After a varying number of hours he is somewhat relieved by troubled sleep; he wakes up next morning, free perhaps from headache; but he is listless; his brain is weary; and he feels as if he had undergone a hard mental struggle. There may be now an interval of a few days, weeks, or years, before the disorder again shows itself.

The headache varies much in character, degree, and duration. In some persons the pain is not localised in any particular spot, but seems generally diffused over the head; others have not noticed that there is more pain on one side of the head than the other, or that the aching radiates from one painful spot, until their attention has been directed to the fact, and then they distinctly recognise it; others, again, have neither vomiting nor nausea; and lastly, the duration of the headache may be very short, or not extend over more than two or three hours, or this symptom may be entirely absent. The disorder may even stop short at the vibratory stage, the vision be restored, and no further inconvenience felt.

In a certain proportion of cases during the vibratory stage a tingling is felt in some portion of the body—the part is 'asleep.' Sometimes it is felt in one arm or in the side of

the tongue, or on the side of the face, and it is on the same side as that on which the glimmering in the eye begins. Sometimes the hearing, speech, or memory is affected.

The age at which the attacks generally commence is from twelve to twenty-five. Females are more liable to them than males. After a certain period, with advancing age the attacks, as a rule, are less easily developed, and become much less frequent. They cease generally after fifty or sixty, and in women not uncommonly at the change of life.

Pathology.—Considerable diversity of opinion exists as to the nature of megrim. Formerly it was regarded as being dependent upon gastric or hepatic derangement—a view, however, which now finds few supporters. Some pathologists hold it to be a form of neuralgia; but though it has a great resemblance to neuralgia, it 'causes much greater disturbance of the sensorium, it spreads much more generally over the head, and is not infrequently accompanied with nausea and vomiting. After the attack there may be an intermission of weeks or months, and the attack itself runs a more uniform or continuous course' (Lebert). The view which the writer has advanced is that the affection is to be referred to the sympathetic nervous system. If by fatigue, anxiety, or other depressing cause, the general tone of the body be lowered, and with it the regulating or inhibitory power of the cerebro-spinal over the sympathetic nervous system impaired, then uncontrolled action or excitement of one or more portions of the latter takes place, causing contraction of the blood-vessels under the influence of the affected portions, and so producing the disorders of sensation which precede the headache; this excitement is followed by exhaustion or paralysis of the sympathetic, and is associated (just as would be the case after section of the nerve) with dilatation of the vessels, and with headache. Dr. Edward Liveing, in his classical and exhaustive work on megrim, combats this view, and maintains that the phenomena are those of 'a nerve-storm traversing more or less of the sensory tract from the optic thalami to the ganglia of the vagus, or else radiating in the same tract from a focus in the neighbourhood of the quadrigeminal bodies.'

Treatment.—By careful management very great relief can be afforded to the sufferers from this malady, not only by diminishing the intensity of the attacks, but also by considerably lengthening the intervals between them. We may consider separately the remedial measures to be employed (1) during the intervals between the attacks; (2) during the premonitory stage or stage of disordered sensation; and (3) during the stage of headache.

1. *During the intervals between the attacks.*—It is to the treatment during this period that the greatest consideration must be given. The cause, if possible, must be discovered, and in a very large majority of cases careful inquiry will reveal the fact that a distinct cause does exist. Overwork, prolonged anxiety, over-fatigue, disappointed hopes or affections, sexual irregularities, defective eyesight, and impoverished nutrition of the body, are among the chief causes; and while these are in operation medicine will prove of little avail. Remove the cause, and then endeavour to brace up the bodily and nervous systems. The chief remedies for this purpose are the vegetable bitters, iron, strychnine, and cod-liver oil. But the success following their use very much depends upon the way in which they are administered. For a day or two after a headache the stomach and bowels may possibly be disordered, and not in a fit state to tolerate iron or cod-liver oil. This condition must be corrected, and for this purpose the simple vegetable bitters, such as gentian with small doses of henbane and some aromatic, may be of service; and if necessary one or two grains of blue pill, with four or five of compound rhubarb pill, may be given at night; but strong purgation must be avoided. Iron may then be given, either in the form of the ammonio-citrate alone, or combined with two or three grains of iodide of potassium; and according to circumstances fifteen or twenty minims of tincture of henbane, or twenty or thirty minims of aromatic spirit of ammonia, may be added to each dose. Or the iron may be given in the form of the mistura ferri composita of the Pharmacopœia; the mixture answering better, however, in some cases without the myrrh. Strychnine is, in the writer's opinion, a very important remedial agent in many forms of this disorder, and may be given with the remedies previously mentioned in the form of liquor strychninæ hydrochloratis or tinctura nucis vomicæ, or may be combined with infusion of quassia or calumba. Where iron is contraindicated from any cause, or when it is not readily borne, the administration of nux vomica with quassia has seemed to act beneficially. In females with a distinct hysterical temperament nux vomica does not answer so well, and better results will be obtained by giving the vegetable bitters with ten-grain doses of bromide of potassium, and fifteen or twenty of tincture of henbane, twice or three times a day. As a rule, however, the bromide is of more use administered during the headache than in the intervals. Cod-liver oil often acts beneficially, especially when there is much nervous exhaustion. It may be given once a day immediately after breakfast, beginning with a small teaspoonful, and gradually increasing the quantity to a tablespoonful, but not beyond, unless in exceptional cases. If the bowels are constipated, five grains or so of the socotrine aloes pill may be given at

night; or if the constipation be habitual, five grains of the aloes-and-iron pill, given twice a day before meals, will generally induce greater regularity in the action of the bowels.

In some individuals megrim is associated with a strongly marked uric-acid diathesis, as shown by the fact that preceding or succeeding an attack the urine is strongly acid and loaded with lithates. In these cases fifteen or twenty grains of salicylic acid, or salicylate of sodium, twice a day, in conjunction with other remedies, to correct or neutralise the uric-acid formation, will often be of signal service.

Other remedies have been recommended, and are sometimes of service, especially arsenic and quinine.

In persons of feeble bodily power, rest is of the greatest importance, and it is often advisable that such patients should remain in bed at least twelve hours out of the twenty-four, and take their breakfast an hour and a half or two hours before rising in the morning. Whenever the headaches recur frequently, this rule should be enforced. In cases where borne, a tumblerful of new milk, to which two teaspoonfuls of brandy, rum, or whisky have been added, may be taken with advantage before breakfast, directly on waking in the morning.

The diet should be liberal; the food plain and easily digestible: and two or three glasses per diem of wine, beer, or porter may generally be taken with benefit, according to the habits of the patient. The more exercise the patient can take in the open air, without fatigue, the better.

2. *During the premonitory stage, or stage of disturbed sensation.*—In the forms attended by disturbance of vision, the longer this lasts the greater will be the headache, and we must endeavour therefore to shorten this stage as much as possible. Directly the glimmering appears the patient should lie down, with the head low; and if the glimmering be on the right or left of the field of vision, he should lie on the *opposite* side. Let him take at once some alcoholic stimulant, a glass of sherry, a tablespoonful of brandy diluted, or a glass of champagne. If alcoholic stimulants be objected to, or if it be not advisable to recommend them, then a teaspoonful of sal volatile in water may be prescribed instead. If the patient be chilly, or his feet cold, the couch should be drawn near the fire, and a hot bottle applied to the feet. By these means the heart is enabled to drive the blood with greater force to the brain, and the duration of the vibratory movement is thereby materially lessened. After the glimmering has passed off, the patient should lie still for a time, so that it may not return. This injunction will only be necessary when the headache is slight; if it be severe, attended with much nausea or vomiting, the patient will be little disposed, or little able, to leave the recumbent position.

If, instead of the disturbance of vision preceding the headache, there be a feeling of depression or irritability, fidgets, and similar phenomena, the administration of such cerebro-spinal stimulants as henbane, valerian, asafœtida, spirit of chloroform, or ether, will often cut short the attack. Fifteen or twenty drops of the tincture of henbane, with the same quantity of spirit of chloroform, will soothe the nervous irritability in the slighter forms, and may be repeated in three or four hours if necessary. If there be great mental depression, then valerian or asafœtida should be tried. Half a drachm to a drachm of the ammoniated tincture of valerian, or the same quantity of the fetid spirit of ammonia, may be given. Sometimes indian hemp is very useful, a quarter to half a grain of the extract in a pill, or five to ten drops of the tincture on a lump of sugar. As a rule, in such cases as these, alcoholic stimulants are not advisable at this stage. A small quantity will cause flushing, heaviness, and slight confusion of thought, without relieving the depression; and though the severe headache may be averted, alcoholic stimulants do not answer so well as the remedies previously mentioned.

3. *During the stage of headache.*—If the headache be slight, and the patient soon able to sit up, there is little to be done. A cup of coffee or tea, cheerful conversation, a walk, drive, or ride, may often help to remove the pain. If, however, the symptoms be severe, then the administration of further remedies is called for. The patient should keep perfectly still and quiet, with the room darkened; for every sound or sight causes pain, and the slightest movement is sufficient to produce gastric uneasiness. Sometimes free evacuation of the contents of the stomach, especially if it contain undigested food, is followed by relief; but, as a rule, it is better to try to relieve and check the vomiting. Iced soda-water, with or without two or three drops of diluted hydrocyanic acid or spirit of chloroform; cold tea; or the effervescing citrate of potassium with diluted hydrocyanic acid, may often afford marked relief. The headache may be lessened by applying cloths dipped in cold water or evaporating lotions to the head. If the extremities be cold, and the headache severe, a warm stimulating foot-bath can be tried, as soon as the nausea will allow the patient to sit up. If the attacks occur in the early part of the day, as soon as the pain has subsided it is generally better for the patient to sit up or move about, or even to take exercise in the open air. During the attack the appetite is diminished, the idea even of taking food provoking disgust. Still, after the nausea has passed away, a cup of soup, or some easily digested food, will often have a good effect in equalising the cerebral circulation, and in relieving the headache. If the head-

ache be severe, bromide of potassium is a remedy which will often prove of great service. It may be given in doses of fifteen or twenty grains, with fifteen or twenty minims of tincture of henbane, and to these may be added thirty or forty minims of the aromatic spirit of ammonia, in some cases with advantage. If necessary, the dose may be repeated after an interval of two hours or so. In some cases phenazone may be given with benefit in doses of seven to fifteen grains, with thirty minims of sal volatile, or acetanilide in five-grain doses, and repeated in an hour if necessary. In other cases, often of a gouty character, chloride of ammonium in doses of fifteen grains produces marked relief, and may be sometimes advantageously combined with spirit of chloroform and compound tincture of lavender. Guarana powder is a remedy which is used, often with happy results. The sick-headaches which it seems to relieve are those in which distinct premonitory symptoms usher in the attack, and particularly those preceded by disturbance of vision. It may be given in such cases in doses of fifteen grains, with the same quantity of sugar, and repeated in from half an hour to two hours. In those individuals, however, in whom the headache is developed suddenly, where the attacks come on without any or with very indefinite premonitory symptoms, guarana appears to have little effect.

As a rule, the use of purgatives in this stage is decidedly objectionable, but occasionally a saline purgative at the commencement of an attack is indicated, and is of service.

PETER W. LATHAM.

MEINBERG, in Lippe-Detmold, in Germany.—Mixed sulphurous saline and chalybeate waters, and mud baths. *See* MINERAL WATERS.

MELÆNA (μέλας, black). — SYNON.: *Dysenteria Splenica*; Fr. *Méléna*; Ger. *Schwarze Ruhr.*

This term is used to denote black tar-like evacuations that are passed from the bowel. The colour and appearance are due to *altered* blood, and the expression is not properly applicable to simple hæmorrhage from the alimentary canal, when blood of a normal appearance is voided.

In order that the blood should have undergone the change which produces the characteristic evacuations, it must have been effused high up in the canal, and in some quantity, as well as retained for some time in the bowel. When hæmorrhage takes place in the lower part of the small intestine, or in the colon or rectum, the blood is passed in a scarcely altered state, or at most renders the fæces dark, without producing the black, viscid motions now referred to.

Blood that is passed into the stomach, from any cause, is subjected to the action of the gastric juice, and undergoes a partial digestion. The acid of the secretion converts the hæmoglobin into hæmatin, a blackish-brown substance, and the exposure of this to the sulphuretted hydrogen produced in the lower part of the intestine converts the iron it contains into a black sulphide. The tar-like consistency is due to the serum, digested clot, and mucus; and the discharged material is usually free from remains of food, being simply altered blood. When the hæmorrhage takes place into the upper part of the intestine, the change is not so completely effected. In place of being submitted to prolonged action of an acid secretion, with considerable power of digesting, the blood is acted upon by alkaline secretions, the efficacy of which is less, unless the ingesta have been previously affected by the gastric juice. The result is that, although the blood is to a great extent altered, and the same black sulphide of iron is formed, it becomes more or less mixed with the contents of the tube, and is not voided in lumpy clots, but almost uniformly incorporated with the fæces, which may be solid, semi-solid, or fluid. The fæces may be blackened by iron, bismuth, and other agents, taken as drugs, but they do not produce the viscid matter like semi-digested blood.

A form of melæna, with or without hæmatemesis, has been occasionally noticed in infants within a day or two after birth. The cause is obscure, but is probably associated in some way with the disturbance of the circulation determined by the ligature of the umbilical cord. Sometimes clean-punched ulcers have been found in the stomach or duodenum in such cases, but oftener there are no indications to be seen *post mortem*. The condition, which is very fatal, is probably allied to other hæmorrhagic states met with in the new-born, such as purpura.

Melæna is the mere expression of a condition brought about by many causes, and these have to be sought for and treated. *See* HÆMATEMESIS; INTESTINES, Hæmorrhage from; and STOOLS.

W. H. ALLCHIN.

MELANÆMIA (μέλας, black; and αἷμα, the blood).—A morbid condition of the blood, in which it contains black and brown pigment-particles. *See* BLOOD, Morbid Conditions of.

MELANCHOLIA (μέλας, black; and χολή, bile).—SYNON.: Fr. *Lypémanie*; *Mélancolie*; Ger. *Schwermuth*; *Melancholie.*—This name is now usually applied to a form of insanity characterised by great mental depression, but formerly it was used by writers to denote *partial* insanity or monomania. The sufferer in this disorder feels his whole existence, mental and bodily, overwhelmed and oppressed by gloom, anxiety, and fore-

boding. At first it may be only a feeling which takes no definite shape, and there may be no delusions. Sometimes, though rarely, there are none throughout; the morbid feeling constitutes the disorder, which in this form has been called *simple* melancholia. Its access is almost always gradual, and though we may attribute it to grief, overwork, or worry, it often happens that no mental or moral cause can be found, and we are obliged to set it down to inherited predisposition, to some debilitating illness, declining strength, or advancing age. Some are aware that there is no real ground for their sorrow and sadness, and are able to look on it as an illness; others feel that there must be some real cause for the despondency, that something terrible is impending, though they know not what. The majority can argue and converse rationally on subjects unconnected with their feeling of misery.

The bodily health, even if at first it appears good, soon participates in the disturbance. The digestion is disordered, the urine loaded with lithates, the skin dry, the bowels constipated, the pulse slow rather than quick, the conjunctiva dull and yellow. The patient will complain of various uneasy feelings in the præcordial or epigastric region, and this, with the state of the excretions, will confirm the notion, so prevalent amongst many, that the whole mischief is in the liver. Such simple depression may continue for a longer or shorter space of time. It may pass away suddenly or gradually, or the individual will grow worse in one of two ways. The depression becomes greater, and delusions of various kinds present themselves; or it is replaced by the excitement of mania.

Melancholia with delusions is far more common than *simple melancholia*, and is that which most frequently we are called upon to treat. The patient feels utterly changed, which he attributes to various causes, and deduces various results from his condition. He has all manner of diseases—syphilis, leprosy, lice; his stomach is gone, and therefore he cannot eat. He cannot attend to business, and therefore is ruined. He is so wretched that he must have committed sins unpardonable in this world or the next. The bodily symptoms, like the mental, are aggravated. Sleep is absent or scanty; and there is rapid wasting. The bowels are loaded, and resist strong purgatives; the tongue is white and furred; the breath offensive. The patients are for the most part elderly; climacteric insanity is almost always melancholia. Of 338 melancholic patients admitted into St. Luke's Hospital only 9 were below the age of twenty.

It cannot be too strongly impressed upon medical men that all melancholic patients, even those whose disorder seems simple and slight, are, especially in the early stage, very apt to commit suicide. We read accounts almost daily in the newspapers of suicides committed by this class of persons; and most lamentable they are, for it is a class which above all others is amenable to treatment.

An asylum is not absolutely requisite for such, if their means allow of proper companions, house, and exercise. They must not be left alone by night or day; must not be left to attendants only; and must have some amusement or diversion. If all this cannot be provided, to an asylum they must go; for if they are resolutely and constantly bent on suicide, it is most difficult to guard against it in an ordinary house.

Whether they are sent to an asylum or not, it is found to be almost invariably necessary to remove them from home. We may think the case a slight one, and may hope that amusement and cessation from work, with medical treatment and good living, will remove the depression. Again and again we are disappointed. The sight of home and home scenes, of family and friends, and the contrast between past happiness and present gloom, perpetuate the melancholy and prevent its dispersion. After valuable time is lost, we are compelled to send away the patient to an asylum or quasi-asylum.

Prognosis.—The prognosis in cases of melancholia is favourable, and patients get well in great numbers, even at an advanced age. It is also important to remember that recovery may take place from this form of insanity after considerable periods of time. The writer has in the second volume of the *St. George's Hospital Reports* recorded three cases of melancholia in which recovery took place after five, six, and seven years' residence in an asylum; and he has since treated a lady who recovered from a most suicidal attack of the disorder after nine years. In dealing with property it is often necessary to consider the question of probable recovery, and it is well to keep in view the chance of it here, although in perhaps every other form of insanity recovery after such periods would be out of the question.

Treatment.—On examination of a melancholic patient, it is generally found that there has been a considerable loss of flesh. This may be due to the mental care and sorrow, but it is often caused by an insufficient quantity of food, which has been scanty, either because all appetite has been lost owing to the prevailing wretchedness, or because, from various delusions, there has been an unwillingness to take food. Moreover, there is almost always considerable disorder of the digestive apparatus, the result and not the cause of the depressed nervous condition. The first thing to be done is to correct this disorder; and then to restore the defective nutrition of the brain.

One symptom is obstinate constipation. It may be necessary in the first instance to relieve the loaded and obstructed bowel by

means of turpentine enemata; after which it will be of advantage to give a daily dinner pill of the extracts of aloes and nux vomica, or a daily teaspoonful of castor-oil, following it up if necessary by an enema, but ensuring an action every, or every other, day, and so habituating the bowels to act. Many melancholic patients, especially women, will be found to be persons who have been accustomed to go for long periods without any action of the bowels, or who never had relief without medicine. Food must be given to this class of patients in large quantities. It constantly happens that it is withheld from them under the impression that their malady is essentially dyspepsia, and that the stomach must not be called upon for much exertion. Many, as has been said, refuse it for one reason or other. In either case the melancholia increases, and the patient gets thinner and weaker. Food must be given with no sparing hand—not merely beef-tea and invalid diet, but solid food, bread, meat, and eggs, with a liberal allowance of wine or malt liquor. Some may require forcible feeding, and this can hardly be carried out except in an asylum; but many by coaxing or threats will take what is given to them with a spoon, and they must be fed frequently till they will take the meals of their own accord. Under this augmented diet the tongue will become clean, the bowels will act without physic, and the patient's appearance will soon testify to the efficacy of the treatment.

Sleep, though not entirely absent here, will be in defect. To procure it opium has been long looked upon as of the greatest value. In melancholia, of all the various forms of insanity, this drug is most useful, and its benefit consists not merely in the procuring of sleep, but in alleviating the feeling of wretchedness. It may be given either by the mouth, or by subcutaneous injection of morphine. It is of importance that we do not give a preparation which shall cause sickness or constipation; the ordinary preparations of morphine, the acetate and hydrochlorate, are apt to do this if given in full doses, and it is better to substitute the solution of bimeconate, Dover's powder, Battley's solution, or solid opium if we can be sure that pills will be swallowed. Chloral hydrate will procure sleep here as in other cases, and may be combined with opium to bring about more speedy action of the latter, but has not such a lasting influence on the malady; when its sleep-producing effect has passed away, the patient does not feel any benefit from the medicine. Paraldehyde, also, is often useful. The bromides should on no account be given. They will increase the emaciation and depression. When the secretions have been corrected, and digestion is re-established, tonics may be useful, especially the preparations of iron and arsenic.

G. F. BLANDFORD.

MELANCHOLIA, Varieties of.—1. **Melancholia, Acute.**—Although the prognosis in simple melancholia, and that which may be called sub-acute, is so favourable, there is an advanced stage which truly merits the name of *acute*, or *acute delirious melancholia*, and generally terminates fatally. The patients are not silent, gloomy, and depressed, but panic-stricken; and in violent frenzy and terror they try to escape from those about them, to tear off their clothes, gouge out their eyes, and injure themselves in every way. They will not lie on a bed unless forced to do so, but will prefer the floor, or incessantly pace the room. Food they resist with all their power, thinking that it is poisoned, or that they will be punished for taking it. Such patients must be fed by force, and fed early, but it often happens that our feeding here is of no avail, and they sink from the exhaustion of this acute disorder. For it is constantly found in those who are already broken and debilitated in health, and is but the last stage of a series of disorders. The incessant agitation, violence, and sleeplessness produce rapid wasting and sinking; the food administered is not assimilated, and fails to restore the wasted force. This form of melancholia runs a rapid course, but nevertheless tends to recovery in the majority of cases. We may administer opium here, with or without chloral hydrate, or paraldehyde; other drugs are of little use. Cod-liver oil may be added to the food. Warmth and stimulants are demanded; and clothes must be kept on by means of a strong suit which cannot be removed by the patient.

2. **Mélancolie avec Stupeur** (Fr.)—SYNON.: Ger. *Schwermuth mit Stumpfsinn.* A more extreme form of melancholia is thus named, where the patient sits or stands, speechless and motionless, and requires to be fed, washed, and dressed. Though such a one will not speak or do anything for himself, he may be watching every opportunity of committing suicide, and he will even strenuously refuse food with the same motive. The vital powers in these persons are greatly depressed, and they require an exceptional amount of nutritious food and stimulant. This form of melancholia has been confounded by some with that variety of insanity termed 'acute dementia' (*see* DEMENTIA); but the latter occurs only in young people, whereas melancholia as a rule occurs in persons of more advanced years; and the early symptoms are quite different, acute dementia coming on rapidly, and without the depression and gloomy delusions which mark the other complaint. G. F. BLANDFORD.

MELANOMA (μέλας, black).—Any morbid growth in which the presence of black pigment is a leading character. *See* TUMOURS.

MELANOPATHIA (μέλας, black; and πάθος, a disease).—An excess of black pigment in the skin, due to abnormal function of the rete mucosum. Melanopathia is rarely general, more frequently partial. In certain instances, as in the 'bronzed skin' of Addison's disease, it is associated with anæmia. *See* PIGMENTARY DISEASES OF THE SKIN.

MELANOSIS (μέλας, black).—According to the present doctrines of pathology, melanosis signifies the condition of system associated with the presence of pigmented tumours. *See* CANCER; and TUMOURS.

MELASMA (μέλας, black).—A term usually applied to excess of pigment in the skin, from abnormal function of the rete mucosum. *See* PIGMENTARY DISEASES OF THE SKIN.

MELLITURIA (μέλι, honey; and οὖρον, urine).—A synonym for saccharine urine. *See* DIABETES MELLITUS.

MEMBRANA TYMPANI, Diseases of.—*See* EAR, Diseases of.

MEMBRANES OF BRAIN AND CORD, Diseases of.—*See* MENINGES, CEREBRAL, Diseases of; and MENINGES, SPINAL, Diseases of.

MEMORY, Defects of.—There are so many different kinds of memory, and so many different degrees of excellence of each variety in different individuals in health, that it is not always easy to say in regard to any particular person how far his memory is defective. In other cases the degree of impairment is so great as to make its existence perfectly obvious. Between such extremes, all intermediate grades of defect may at times be met with. The nature and causes of the various defects of memory cannot possibly be set forth without giving some account of the different physiological processes involved in its exercise; and also of the several fundamental modes in which this is brought about.

THE COMPONENT PROCESSES IN MEMORY.—What is commonly known as 'memory' is dependent upon two kinds of processes. The *first* of these is a vital, molecular, or organic process of some kind, taking place in various parts of the brain simultaneously, on the occurrence of some 'perceptive act' or thought-process. In a healthy and properly nourished brain certain neural processes, in different regions of tho organ, are supposed to coincide with each act of perception and apprehension. Similarly, in 'ideation' or roflection, molecular processes of a closely related kind are presumed to take place, partly in the areas of the brain concerned with perceptions and partly in other regions, and these several changes have the samo kind of relation to our thoughts that the others have to our porceptions; in each case they, in fact, constitute the organic basis of the respective processes. These initial organic changes of all kinds were referred to by Laycock, and comprised under the namo 'synesis.' The first essential, thorefore, for the oxercise of memory is that these synetic processes should have bcon properly accomplished. If they havo been imperfectly performed, memory will be either defective or non-existent.

Yet these processes constitute the foundations for memory, rather than memory itself.

Memory essentially consists in a repetition or weak revival of such molecular movements and processes in nerve-tissues, and of the conscious states associated with them. They are similar in kind, and take place in all such parts of the brain as were concerned with the original conscious realisation of the objects, relations, or processes which now recur as 'remembered' impressions or thoughts. This, therefore, is the *second* of the processes above referred to, as essential to the exercise of memory.

MODES OF EXERCISE OF MEMORY.—The repetition or weak revival of foregone processes, and of their associated conscious states, is brought about in three modes fairly distinct from one another. The first mode of exercise of memory (*a*) is found in acts of perception, when, on the presentation of some object to the sense of sight, hearing, touch, smell, or taste, or to any two of them, the remaining qualities of this object become nascent or revived in memory, so that the object itself is perceived or recognised as being of such and such a nature.

This kind of process is only impaired where the nutrition of the brain as a whole is gravely interfered with. Special parts of such a process are, however, not infrequently interfered with by local brain-disease, as when, for instance, the sight of a written or printed word does not rouse its appropriate related memories; or when a spoken word remains unrealised or unapprehended, because its mere sound does not excite all the memories which should cluster round it; in the one case we have what has been rather inappropriately termed 'word-blindness,' and in the other 'word-deafness.' The one set of persons exhibiting such defects may be perfectly well able to recognise natural objects or persons by sight, just as the others may be able to appreciate different kinds of natural sounds, or differences in emotional intonations of the voice, although particular words may not call to their mind any distinct apprehension of the thing, idea, or relation which they are usually employed to designate.

The second, or most common mode in which memory is exercised is (*b*) during the ordinary course of thought, when by natural processes of 'association' the ideas of objects, of persons, of ovents, and of their relations one with anothor and with ideas, recur to consciousness, with or without a simultaneous

full realisation of the words suitable for the expression of all these phases of our thoughts—according as we are merely thinking to ourselves, or as we at the same time give expression to our thoughts whilst conversing with another person. These, together with the kinds of exercise first referred to, constitute by far the most frequent modes in which memory is called into play. It here manifests itself in a purely automatic manner, without sense of effort on our part (other than that which is concerned with the direction of our thoughts), owing to the fact that present cerebral activities tend to recur in the manner and order which have been most frequently repeated in the race and in the individual—such manner and order necessarily varying according to the particular direction and nature of their or his education, natural or acquired. The study of this order corresponds with the study of the order of mental phenomena, and has resulted in the establishment of certain so-called 'laws of the association of ideas.'

The process by which language incorporates itself with all our perceptions and thoughts is not different from that which associates perceptions and thoughts among themselves. It is, however, a more special association; and consequently a weak or failing memory—whether resulting from old age, brain-shock, or malnutrition—is peculiarly apt to show itself in this direction, and that more especially by an inability to revive the cerebral processes connected with the names of persons, places, or things (*see* APHASIA). But this kind of defect has to be distinguished from the inability to utter or to write words which are nevertheless remembered, that is, where the cerebral processes associated with the word as a mental symbol may be revived, in the main, in some portions of the brain concerned with the reception of auditory impressions, though incitations may not be able to pass over from these centres so as to revive nerve-processes in other centres of the kinæsthetic type, by which the word is either spoken or written, according as the one or other effect is desired (*see* APHASIA). The loss of verbal memory is in these latter cases not so real as it seems to be, and such defects may, moreover, be induced by quite limited cerebral lesions.

In the third mode of exercise of memory (*c*) there is no longer the easy flowing mechanical revival of foregone processes, together with the simultaneous recurrence of copies of foregone phases of consciousness, which should characterise the modes of exercise above alluded to. Now there is a delay in the process of automatic revival; a vague sense of effort intervenes at some stage of the thought-processes, similar to that of which we are conscious when we attempt to 'guide our thoughts' into particular channels; we strive 'by way of association' to find some new molecular channel by means of which the cerebral processes concerned with the forgotten name, event, idea, or relation, may be roused anew, in order that we may 'recollect,' or recall by voluntary effort, what may be needful for the continued expression of our thoughts.

This latter process of 'recollection' is therefore that which is rendered necessary by the first stage of faultiness of memory, a condition which may obviously be brought about in altogether different modes, to some of which we are now about to refer.

ÆTIOLOGY OF DEFECTIVE MEMORY.—It seems clear, on the one hand, that for memory to be good (*a*) the preliminary process of synesis must have been well accomplished. Yet this first and essential condition may be defective from various causes. (1) The original plasticity or receptive potency of the nerve-tissue may have been inferior from birth; or it may have been temporarily lowered by conditions of malnutrition, such as are not infrequently met with in persons who have suffered from severe fevers or from other exhausting diseases. On the other hand, the potency of the nerve-tissue may be good, and yet the processes of synesis may have been badly effected, owing (2) to the individual's lack of attention at the time when what is now to be remembered originally engaged his consciousness; for no truth is more obvious in regard to memory than that of its dependence upon the degree of attention bestowed upon the original impressions or ideas. Those which have been vividly attended to at the time, from whatever cause, tend to become indelibly 'stamped upon the memory,' and all the more so because such impressions or ideas are prone to be often thought of, and thereby strengthened by each revival of the cerebral process; whilst those that have slightly engaged our attention are apt not to be revived, and to be after a time effaced, though it is in this respect especially that so much of individual difference is met with. Greatly diminished power of attention is, moreover, commonly met with in exhausting diseases, and in multitudinous brain-affections.

But, on the other hand, however well the process of synesis may have been accomplished originally, this will be altogether unavailing if (*b*) the avenues are damaged or impaired by which associated processes transmit their stimuli. The automatic excitation of memory is then hindered. Thus, to take only one example, if certain commissural connexions be severed between what we may term the visual and the auditory word-centres, a person may be able to read so as to understand the words which he sees, and yet not be able to pronounce one of them, because the associational stimulus cannot pass to the corresponding part of the auditory word-centre, so as to rouse this

particular memory or idea of the word, from the molecular processes concerned with which the outgoing stimuli issue for its pronunciation.

Again, however well the process of synesis may have been originally performed, if (*e*) the whole nutrition of the brain becomes lowered by exhausting disease or old age, failure of memory may present itself because attention cannot be adequately roused, and the cerebral processes generally are too feeble to propagate themselves, as they would have done formerly, into the various collateral channels, so as to rouse the activity of all the previously associated brain-regions necessary for the full realisation of the thoughts of the moment.

From what has been already said, it will be seen that defects of memory may result from very various causes, according as they impede one or other of the successive processes upon which memory depends. Thus, they may depend upon (*a*) synetic defects; upon (*b*) associational defects; or upon (*c*) expressional defects.

Pathology.—In all those cases in which we may presume that synesis is impaired, we may expect also to find evidence of a greatly weakened power of attention, and there may in addition be an impaired perceptive power. Such defects are mostly dependent upon general causes, affecting the nutrition of the brain as a whole. A condition of this kind may be only temporary, and then, whilst recent events are speedily forgotten, it may happen that the memory of old impressions remains fairly good, or may even be marvellously intensified, so that long-forgotten occurrences or knowledge become revived. At other times the patient's mind may for a time be reduced to a perfect blank—old and recent knowledge, familiar and unfamiliar, is alike blotted out; though after a time recovery of memory may take place, either slowly or with comparative suddenness. In cases of epileptic mania, and in many instances of brain-shock from blows upon the head, the patient may lose all memory of immediately preceding events.

Where the secondary process of revival is that which is interfered with, the loss of memory is generally most manifest in regard to words. The processes of association by which these are recalled to memory are either impaired or disturbed, so that we get one or other variety of amnesia induced, either of the paralytic, or of the incoördinate type (*see* Aphasia). Such amnesic defects are, in the opinion of the writer, specially prone to be induced by lesions of the convolutions contiguous to the posterior extremity of the Sylvian fissure.

Where there is mere loss of power to express thoughts, the loss of memory is often more apparent than real, and is due to a mere non-revival of certain kinæsthetic processes—thus causing paralysis of speech and writing as motor acts (*see* Aphasia). And these conditions, either singly or in combination, are also apt to be induced by lesions in the hinder part of the third or of the second left frontal convolution, or of regions between these gyri and those bordering upon the posterior extremity of the Sylvian fissure traversed by their commissural fibres.

Treatment.—The treatment of these defects of memory naturally resolves itself into that of the various general or local morbid conditions upon which they depend, to which reference has been made in the sections on Ætiology and Pathology. Our greatest successes will be in cases in which defects of memory are dependent upon lowered conditions of general health, with defective nutrition of the brain. Here tonics, such as liquor strychninæ hydrochloratis and liquor arsenicalis, alone or combined with preparations of iron or hypophosphites, may do much good. Their action may be aided by maltine and cod-liver oil, together with rest, if the brain functions have been enfeebled by overwork. Where memory is defective in the young from faulty attention, much may be done to strengthen it by the judicious exercise and cultivation of these faculties, either by the patient alone or with the aid of a tutor.

H. Charlton Bastian.

MENIDROSIS (μήν, a month; and ἱδρώς, sweat).—A term applied to vicarious menstruation by the skin. *See* Sudoriparous Glands, Diseases of.

MENIÈRE'S DISEASE.—*See* Vertigo.

MENINGES, Diseases of.—The treatment of this subject is naturally divisible into two main heads. We have to consider (1) the morbid conditions resulting from disease of the **Cerebral Meninges**; (2) those of the **Spinal Meninges.** Though most frequently affected separately, still it happens on some occasions that these two main divisions of the membranes surrounding the great nerve-centres are simultaneously diseased. This is the case, for instance, in *epidemic cerebro-spinal meningitis*, an important general disease, which is considered in a separate article (*see* Cerebro-Spinal Fever). A similar diffusion of inflammation also occurs, but more rarely, in cases of *sporadic cerebro-spinal meningitis*, which may be sometimes 'simple,' and sometimes of the 'tubercular' order. In the articles that follow, the several diseases of the cerebral meninges and of the spinal meninges will be separately discussed.

MENINGES, CEREBRAL, Diseases of.—Synon.: Fr. *Maladies des Méninges Cérébrales*; Ger. *Krankheiten der Hirnhäute.*—The following morbid conditions, and varieties of such conditions, have to be considered under this heading:—

1. *Inflammation*—of several varieties.

Inflammation of the cerebral meninges occurs from various causes, and also affects various parts of the membranes, so that the subjoined varieties of the disease will have to be separately considered:—

(*a*) *Simple Meningitis* { α. Idiopathic. β. Traumatic. }

(*b*) *Tubercular Meningitis.*

The simple meningitis of traumatic origin occurs under three pretty distinct forms, according as it affects the dura mater—*pachymeningitis*; the surfaces of the arachnoid—*arachnitis*; or the meshes of the pia mater beneath this membrane—*leptomeningitis.* Both the *idiopathic simple meningitis* and *tubercular meningitis* are forms of leptomeningitis. All are acute diseases.

Concerning *chronic meningitis* we have more of pathological than of clinical knowledge, though even as regards the former side we are bound to say that much of the thickening and opacity of the arachnoid, formerly regarded as due to 'chronic inflammation,' is rather a mere result of degenerative overgrowth—partly brought about as an appanage of advancing age, and partly as a consequence of frequent or long-continued congestion. Still, such conditions may at times be coupled with more distinctive evidences of actual chronic inflammation, for example, in some cases of chronic mania, and also in general paralysis of the insane.

Good reasons, moreover, exist for believing in the frequent clinical existence of local chronic inflammation of the meninges, as evidenced by the presence more especially of localised pain and of tenderness on slight percussion, coupled with other head-symptoms. Fortunately for the patient, however, we have often no opportunity of verifying this diagnosis, because such a condition is of itself not likely to lead to fatal results. It may follow a blow; it may occur as one of the consequences of constitutional syphilis, or it may manifest itself independently of either of these causes. Chronic syphilitic meningitis is the best known of these varieties. Its associated morbid conditions are, however, most closely related to another set of changes, which will be described, and in which we have to do with new-growths or 'gummata.'

Two other varieties of meningitis are occasionally met with as rare events: first, an inflammation limited to the envelopes of the cerebellum, or extending from it only to the pons Varolii; and, secondly, an inflammatory condition of the lining membrane of the lateral, and perhaps of the third ventricles. The natural history of these states is at present so little known as not to admit of systematic treatment. Their ætiology and symptomatology have still to be established. This form of basal meningitis the writer has seen presenting symptoms indistinguishable from those met with in many cases of tumour of the cerebellum.

2. *Hæmorrhage.*

3. *Hæmatoma.*

4. *New-growths* and *Adventitious products.*—Under this head are included, besides the different kinds of tumours originating in the meninges, other bodies of quasi-accidental origin, which may be met with in the cavity of the arachnoid, in the meshes of the pia mater, or in connexion with the vessels of these parts.

5. *Malformations.* *See* BRAIN, Malformations of.

H. CHARLTON BASTIAN.

MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.—SYNON.: Simple Idiopathic Cerebral Leptomeningitis; *Leptomeningitis Infantum* (in part); Fr. *Méningite Simple*; Ger. *Acute Hirnhautentzündung.*

DEFINITION.—A simple non-tubercular inflammation of the cerebral pia mater, which may be either limited to the convexity, general, or confined to the base of the brain. It is associated with very variable symptoms in different cases; and is probably caused in many different ways.

ÆTIOLOGY AND PATHOLOGY.—Our knowledge of the ætiology and pathology of acute idiopathic cerebral meningitis is only vague and indefinite, so that little but unconnected statements or mere suggestions can be here set down.

It appears that sex exercises an influence in the production of idiopathic meningitis, and that the disease occurs much more frequently in males than in females. In regard to age, it is met with almost as frequently in individuals from ten to twenty as in those below the tenth year. In individuals over twenty the disease is much more rare.

Meningitis is apt to occur during, or as a sequence of, some acute febrile disease, such as measles, scarlet fever, small-pox, and rheumatic fever. It may complicate erysipelas of the head and face; or may occur in the course of pneumonia or pleuro-pneumonia; also as an accompaniment of ulcerative endocarditis or pyæmic processes, owing to these conditions leading to minute embolisms of the vessels of the pia mater. Sometimes it is met with in extremely cachectic subjects, who have not previously been suffering from any acute disease. It has been known to follow prolonged exposure to the sun; to ensue after the occurrence of severe moral perturbations; and likewise to follow a shock or blow, even when this has not been complicated with an external wound, or with a fracture of one of the bones of the skull.

In other cases, also, a meningitis really

secondary may appear to be primary and idiopathic, as when (*a*) it extends from some focus of syphilitic disease of the meninges, or (*b*) when it occurs as a sequence of some unrecognised chronic inflammation involving the middle ear and portions of the temporal bone.

Anatomical Characters.—Simple idiopathic inflammation of the cerebral meninges is a condition which varies much in severity in different cases. In its earliest or initial stage, nothing more than a minute and more or less uniform injection of small vessels and capillaries in certain regions of the cortex may be met with. But later on, definite products of inflammation are to be seen; these are for the most part situated beneath the arachnoid, in the meshes of the pia mater. They consist, according to the stage of the morbid process, either of a gelatinous white or yellow lymph-like matter, of actual pus, or of more coherent yellow lymph in the form of membranous layers. In regard to the area involved considerable differences also exist. The inflammation (1) may be limited to the convexity and to the lateral regions of both hemispheres; (2) it may be general, that is, involve the parts above mentioned, and also the base; or (3) it may be limited to the basal regions of the brain. In both the latter cases the ventricles are apt to contain fluid, and the central parts of the brain to be softened, as they are in tubercular meningitis, which also affects the base in a special manner.

Of these varieties as to seat, the first, in which the convexity is involved, is decidedly the most typical, and in this respect simple idiopathic meningitis contrasts in a salient manner with tubercular meningitis, in which the tendency is no less marked to implicate the base of the brain. In the second variety, the inflammation beginning above probably extends to the base by mere continuity, in cases where the condition of the patient, or the intensity of the inflammatory process itself, favours its spread from the original site; or, in certain cases, the inflammation may be from the first general in seat. In regard to the third variety, much doubt may be said to exist. It is by no means clearly established that a simple idiopathic inflammation ever begins to manifest itself at the base, and there only—though no good reason can be assigned why such a distribution should not occasionally exist, except that experience shows it to be at least very rare. If, moreover, such an inflammation be not of unsuspected traumatic origin, there are still two other modes of accounting for its existence, which should be excluded before regarding it as an idiopathic cerebral meningitis of unusual site. Thus, it may be an extension upwards from the spinal meninges of an inflammation beginning there—a case, in fact, of cerebro-spinal meningitis, either sporadic or epidemic. Or, on the other hand, it may be one of those cases of tubercular meningitis where the general disease manifests itself on the side of the brain first, and in which the patient dies before the local process is at all fully developed. In such a case the inflammation may be really of the tubercular variety, and yet to superficial observation not recognisable as such. Although neither of these misconceptions is likely to occur often when the necropsy is made by a competent observer, the case may be otherwise, and either of such mistakes as to the real nature of the affection is more especially apt to occur where the head only is examined.

In all these cases, too, the inflammation may be limited to the meninges themselves, or the surface of the brain may also be manifestly involved in the inflammatory process, so that we then have to do with a *meningo-cerebritis* of varying seat and extent.

Symptoms.—In no disease is the symptomatology more various than it is in acute meningitis—a fact partly due to the varying intensity of the inflammatory process, partly dependent upon the process being localised or more general, and partly according as there is or is not the co-existence of dropsy of the ventricles with inflammation of their walls. Sometimes the disease is almost latent, accompanied only with slight symptoms, merging into stupor and coma a day or two before death. Or the symptoms may be marked and quite tragic in their severity; ushered in either by frightful pains in the head, by well-marked delirium, or by convulsions; subsiding eventually into a condition of stupor or coma; and followed by death within eight or ten days, though this may be delayed till the expiration of three weeks or a month. Recovery, which sometimes occurs, must be regarded as a rare event.

Inasmuch as it is not practicable, within the limits of this article, to give a detailed account of the various groupings of symptoms that may be met with in different cases, we must confine ourselves to an enumeration of the symptoms themselves, most apt to occur (1) in the early stages of the disease, and (2) in its later phases.

(1) Cephalalgia of an intense character, either general, or localised in some particular region or regions of the head, may be complained of again and again where the patient is old enough, or, if he be too young, is indicated by cries, by application of the hands to the head, or by other signs. Sometimes, however, this symptom may be almost absent, or it may come on at a later date. Delirium, occasionally furious, at other times more quiet and of a simply loquacious type, is another symptom; or extreme restlessness. Mere insomnia, too, sometimes exists

from the commencement; whilst at other times a semi-comatose condition, gradually deepening into actual coma, may exist from the first, especially in children, or it may succeed a transitory delirious condition. Nausea and vomiting, and also convulsions, either local or general, may be met with in the early stages of the disease, and sometimes as initial symptoms. With them will go general pyrexia and sometimes rigors; also heat of head, rapid pulse, a furred and often thickly coated tongue, constipation, perhaps some intolerance of light and of loud sounds, together with an easily obtainable *tache cérébrale*.

(2) As later symptoms, we may have localised convulsions or spasms, often of the tonic order, affecting perhaps the head and neck (which are frequently drawn backwards) or one or both arms; or a condition of trismus may exist. The eyes, too, are sometimes drawn upwards. The pupils may be at first contracted, or, if not, they may be of medium size, unequal and insensitive; whilst later on they are most frequently widely dilated and insensitive. The conjunctivæ are often injected. Paralysis of one arm, or sometimes of an arm and a leg, may occur. The sensibility of the skin may be either exalted or deadened. The abdomen is often hollow and boat-shaped. The tongue becomes thickly coated, or dry and brown. Difficulty of deglutition is frequently well marked towards the end; and there is incontinence of fæces and urine as soon as the stupor becomes marked. Sometimes the pulse is unnaturally slow and infrequent from the first; at other times, and especially towards the end, it is very frequent and irregular. The respiration, too, becomes much disturbed, being often sighing and of very irregular rhythm, tending to become stertorous at last. The temperature is frequently high, but pursues a markedly irregular course. Remissions of the pyrexial condition may take place from time to time. The skin is generally hot and dry, though occasionally there may be copious sweats. Stupor and coma almost invariably occur at the last, if not present at an earlier stage.

Prognosis.—A large number of deaths take place within the first week of acute meningitis; a much smaller number survive till the end of the second week; fewer still reach the end of the third; and only a very few survive to the fourth week. It is difficult to say what the percentage of recoveries may be; but probably less than ten would survive out of a hundred cases of acute idiopathic cerebral meningitis.

Diagnosis.—The diagnosis of idiopathic meningitis involves considerations very similar to those arising in the diagnosis of tubercular meningitis, and need not therefore now be discussed. *See* Meninges, Cerebral, Inflammation of, Tubercular.

The diagnosis of simple from tubercular meningitis must oftentimes be a matter of extreme difficulty. Whether the condition of the blood, as recognised by the aid of the microscope, is the same in simple meningitis as it is in tubercular meningitis the writer is unable to say. Should it not be so, some help might be obtained in this direction. The conditions under which the disease seems to develop may throw some light upon the problem. In regard to special symptoms, the possible range is so great in each variety that it becomes difficult to fix upon any that are positively distinctive of the one or of the other. Delirium is, however, rarely so violent in tubercular as it may be in simple meningitis. Retraction of the head is also not so frequent in the tubercular variety. On the other hand, the temperature much more frequently rises over 101° F. in simple than it does in tubercular meningitis. Finally, it must be borne in mind that the former is an extremely rare disease, the latter unfortunately only too common; and that whilst in tubercular meningitis the two sexes fall victims with about equal frequency, in the simple variety two out of three are likely to be males.

Treatment.—In the early stages of acute simple meningitis aperients may be freely administered. A leech or two might be applied to the temples, in cases where pain is greatly complained of; or under the same conditions the head may be shaved and an ice-bag or Leiter's tubes may be applied, should such measures not be deemed useless on account of the extreme restlessness of the patient. The writer believes that little or nothing is at present to be expected from drug treatment towards the cure of this disease, although some alleviation of the more distressing symptoms may at times be brought about by special attention to them. The patient requires to be carefully fed, and assiduously nursed and kept quiet throughout, in the hope that the end may be favourable. H. Charlton Bastian.

MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.—Several distinct forms of meningitis, of traumatic origin, have to be carefully distinguished from each other. We have (1) a meningitis in which the outer surface of the dura mater is the part chiefly affected—*pachymeningitis*; (2) one in which the cavity of the arachnoid is the seat of the effusion—*arachnitis*; and (3) one in which both these escape, and the subarachnoid spaces, or, it may be, the structure of the pia mater, is primarily involved—*leptomeningitis* or *subarachnoid meningitis*. For the most part, it is possible to distinguish these forms at the bedside, as well as in the *post-mortem* room. Sometimes the case is of a mixed form; especially is it not uncommon for an inflammation

which had begun between dura mater and bone to extend through the fibrous membrane, and involve the arachnoid beneath it; but it is still a remarkable fact in pathology that very frequently the delicate arachnoid suffices to restrict an extensive inflammatory process to one or the other side of it.

Of the inflammation between the dura mater and bone it is possibly true that it occurs only in association with disease of the bone. If there be any exceptions to this latter statement, they occur probably in connexion with syphilis. Occasionally cases are met with in which the arachnoid cavity itself contains puro-lymph, the surface of one hemisphere, for instance, being covered, and yet there is no history of injury or of prior inflammation of the scalp or bone. Such cases are, however, rare, and their possible causes need further investigation.

In a general way, children may be deemed more liable to meningitis after injuries than adults, and in them not very infrequently severe and fatal complications ensue after injuries not attended by fracture.

1. **Pachymeningitis.**—Inflammation of the meninges secondary to inflammation of the bone is one of the commonest of the dangers which attach to injuries to the head. The bone is contused, and in most cases there is some stripping off of the pericranium.

Symptoms.—For a week or ten days the patient does well; and then he begins perhaps to complain of headache, feels chilly and uncomfortable, and cannot eat. These symptoms increase, and drowsiness and semi-stupor may come on. If the ophthalmoscope be used, very possibly at this stage the discs may be found hazy and swollen; and this may occur with little or no evident defect of sight. If the trephine be now used, the bone will be found discoloured, its diploe greenish, and beneath it a collection of pus. The pus is rarely in large quantity, and is usually discoloured, whilst all around the collection of fluid there is much coherent and sticky lymph, which loosens the membrane from the bone. It is very rare to find a large abscess, such as those described in the celebrated cases given by Pott. Usually the termination of such cases is that the substance of the dura mater inflames; that the arachnoid is implicated; and that a layer of puro-lymph lines that membrane, and coats the hemisphere. With this state special symptoms are associated, the most noteworthy being hemiplegia of the opposite side. Very commonly, however, another event cuts short the case. In mentioning the early symptoms nothing has been said as to rigors, nor do they, as a rule, occur, unless the complication just hinted at is developed. That complication is pyæmia. This pyæmia has no essential connexion with the meningitis. It depends upon the inflammation of bone, which is the common cause of both, and which may be the parent of either singly, or of the two as twins. With the gangrenous osteitis occurs gangrenous phlebitis of the veins of the diploe; from these the process extends to the proximal sinus of the brain (more commonly the superior longitudinal); infective emboli of decomposing material gain access to the circulation; and all the well-known phenomena of pyæmia follow. It is most important to distinguish the symptoms which belong to the pyæmia, if we would rightly estimate those due to the meningitis, for very frequently they are met with together. Especially must we remember that a severe rigor probably denotes pyæmia; and that, if it be repeated, the diagnosis of this affection is almost certain. It is the almost constant complication with phlebitic pyæmia, which so almost invariably disappoints the surgeon of any benefit from the use of the trephine in this group of cases. If pyæmia does not occur, then probably arachnitis is there, and thus it comes to pass that a recovery after secondary trephining is almost unknown.

Treatment.—But little is to be done as regards treatment for this form of osteitic meningitis; the main thing is to adopt measures for its prevention. The careful management of the wound, either by Lister's plan or by the constant use of the lead and spirit lotion, and the exemption of the patient from all risk of contagion, are the matters which will chiefly claim attention. In cases of depressed compound fracture without symptoms, one of the objects of primary trephining is to prevent meningitis, by removing displaced fragments, and by affording free exit for secretions.

2. **Arachnitis.**—The form of meningitis to which the term 'arachnitis' is applicable is a frequent consequence both of inflammation of contused bone and of wounds of the membranes. Enough has already been said as to the circumstances under which it occurs after contusions of bone, and we have chiefly now to examine its pathology and special symptoms.

Anatomical Characters.—In the *post-mortem* room arachnitis may be easily distinguished from inflammation in the subarachnoid spaces, and the distinction ought always to be carefully made. In arachnitis the puro-lymph covers the cerebral convolutions in an even layer, and does not dip into the sulci, to which, indeed, it has no access; whereas, when the spaces are affected, the sulci are filled, and the convexities of the convolutions remain free. In the latter none of the effusion can be peeled or sponged away, nor does any adhere to the parietal arachnoid. In true arachnitis both the parietal and visceral layers are smeared over.

Symptoms.—One of the earliest signs of

arachnitis occurring after an injury to the head is a peculiar restlessness or nervousness, followed by vomiting. These symptoms may come on first from five days to a fortnight after the accident. Many cases of compound fracture of the skull, with laceration of the dura mater, afford us good opportunities for the study of acute traumatic arachnitis; but, unfortunately, in many of these cases the brain-substance is also punctured, and it becomes at least possible that the condition described as diffuse encephalitis may be present, and may complicate the symptoms. We are helped, however, as regards the avoidance of fallacious inferences by the other set of arachnitis cases, where the arachnitis is secondary to osteitis, in which, there having been no injury to the brain, there is no probability of encephalitis. Speaking, then, from the result of observation of both classes, it may be stated that whenever evidences of arachnitis are found widely spread over a whole hemisphere, there has been during life hemiplegia of the opposite limbs. Exceptions, apparent or real, occur to this, but they are rare, and probably most of them are apparent and not real. The risk of error lies in the case in which, in a patient who is very ill, hemiplegia, which supervened gradually during the last day or two of life, may have been overlooked. The hemiplegia is rarely complete, and, unless the limbs be carefully tested at each visit, both patient and surgeon may be unaware of its presence. Its degree is proportionate to the extent of the arachnitis; and if the latter pass under the falx and involve the opposite hemisphere also, there may be general weakness of all the limbs, which may again to some extent mask the hemiplegia. It is almost certain that the hemiplegia has little or nothing to do with pressure from effused fluid, for the latter is rarely in large quantity. Its immediate cause is, indeed, not very obvious; but as the grey matter of the cortex is almost always discoloured, and changed from a pink tint to a greenish slate hue, it may be conjectured that this in some way has to do with the symptoms. The other symptoms which attend acute diffuse arachnitis are—wandering delirium, rarely violent; increased temperature; incontinence of urine and fæces (part of the hemiplegia); and occasionally unilateral sweating. It should be remarked that the hemiplegia involves both sensation and motion. As, however, it is incomplete, the defect in sensation is almost certain to escape notice. Patients who are obliged to admit that they cannot move their limbs forcibly, will deny that there is any defect in feeling, and it is often impossible to confute them. In well-pronounced cases, however, sensation always fails as well as motion.

Treatment.—It is doubtful whether recovery ever takes place after this form of arachnitis has become well established; and here, again, we have to think rather of prevention than of cure. Cold to the head—spirit lotions being the most convenient form—and very early and efficient resort to mercury, are the chief measures where the dura mater is known to have been lacerated. Strong spirit lotions should be used from the first, and mercury also given. It is too late to commence the exhibition of mercury after the symptoms of arachnitis have set in. Amongst the measures of treatment of more doubtful value are the administration of aconite, in small doses frequently repeated, leeches, blisters, and fomentations. If blisters are used, they should be applied to the neck, or back, or shoulder.

3. **Leptomeningitis.**—This form of traumatic meningitis, which occurs in the subarachnoid spaces, is an exceedingly interesting malady.

Ætiology.—Leptomeningitis may be encountered after any form of injury to the skull involving laceration or puncture of the visceral arachnoid, but its most typical illustrations are witnessed after fracture through the petrous portion of the temporal bone. This fracture, although usually counting as a simple one, is in reality compound, in that it opens up access to an air-containing cavity. It is possible that air may reach the injured bone either through the external ear or the Eustachian tube.

It is a matter of some interest to determine whether arachnitis of these spaces often, if ever, results from severe concussion without any fracture, or after simple fracture without any possibility of admission of air. Whilst it is impossible to speak clearly on this point, it is highly probable that it occasionally does so.

Anatomical Characters.—Results which are scarcely ever witnessed after simple fractures in other regions of the skull may occur here, a fact which can only be explained on the supposition that we have to encounter the risks incident to compound lesions. Amongst the results referred to is the frequent development, some days after the accident, of inflammation in the large subarachnoid spaces at the base of the brain. It is probable that the inflammatory process travels along the course of the nerve-trunks (seventh nerve), and thus gains access to the spaces. Affecting first the parts adjacent to the roots of the nerves, the inflammation may spread downwards on the medulla and cord, or upwards through the posterior fissures into the ventricles, or over the surface of the hemispheres. Usually it is almost confined to the base of the brain and medulla oblongata. These parts are coated with serous lymph, which invests them closely and adheres to all the nerve-roots passing from them. The layers of arachnoid which cover in and confine the exudation remain quite transparent, and show no traces of

lymph on their inner surface. It is only when these layers are cut or torn that access to the inflammatory effusion is gained. In performing the necropsy it is needful to use care lest this laceration be made by accident, and the characteristic appearance somewhat spoiled.

Symptoms.—Patients suffering from this form of basal subarachnoid inflammation may become delirious and die very quickly in the first access of the morbid action; but, on the other hand, and more usually, they may live for several days, or a week or two, and show only comparatively mild symptoms. Absolute sleeplessness, with occasional wandering, but without any degree of paralysis, was the most prominent symptom in one very well-marked case. It is probable, though not as yet established, that optic neuritis often attends this form of meningitis. The temperature may be an important aid in diagnosis: in cases of lepto-meningitis it appears to be *always raised*—perhaps continuously 101° to 104°. That the subarachnoid spaces are affected may be plausibly suspected whenever, after supposed injury to the base of the skull, vague cerebral symptoms, unattended by definite paralysis, supervene; and if there have been bleeding from the ear and deafness, with facial paralysis in the first instance—a triad pathognomonic of fractured petrous bone—then this is the form of meningitis certain to follow, if any.

Prognosis.—As regards recovery from traumatic meningitis of the base, what has been said on the difficulties in forming a confident opinion as to its presence will sufficiently explain the impossibility, in any given case in which recovery has resulted, of feeling sure that the inflammation in question had really existed. Many patients, however, recover more or less, often perfectly, after prolonged and severe symptoms following fractured base. Some of these are doubtless recoveries from severe contusion only, but others, especially those in which serous fluid and even blood has drained away from the ear, may be plausibly conjectured to be recoveries from meningitis of the base. Recovery has taken place in cases where the occurrence of optic neuritis and strabismus and other symptoms some days after concussion has made that diagnosis certain.

Treatment.—The measures of treatment likely to conduce to recovery in such cases are the same as those prescribed for other forms of meningitis. Mercury carried to the extent of ptyalism is the chief agent; and so impressed has the writer for long been as to the danger of the malady, and the value and harmlessness of the drug, that he has been in the habit of giving it from the first in all cases in which fracture of the petrous bone has been diagnosed.

Jonathan Hutchinson.

MENINGES, CEREBRAL, Inflammation of, Tubercular.—Synon.: Granular Meningitis; Acute Hydrocephalus; *Hydrocephalus Internus*; Brain Fever (in part); Tubercular Leptomeningitis; Fr. *Fièvre Cérébrale*; *Méningite Granuleuse*; *Méningite Tuberculeuse*; Ger. *Tuberculöse Hirnhautentzündung*.

Definition.—An acute and extremely fatal febrile disease, with a predominance of head-symptoms; terminating in stupor and coma, with or without convulsions; and characterised after death by a 'granular' meningitis affecting the pia mater at the base of the brain, with the frequent accompaniment of dropsy of the lateral ventricles, and softening of their walls. The inflammation of the membranes at the base of the brain is often found to be associated with a spinal meningitis.

Tubercular meningitis is not an independent affection; it constitutes one important phase of a many-sided general disease commonly known as Acute Tuberculosis, and marked anatomically by the presence of 'grey granulations' within the thorax and abdomen, as well as in the membranes of the brain. In certain rare cases death takes place from granular meningitis, before the anatomical marks of the general disease have had time to develop within the chest or abdomen. More frequently, however, the manifestations of the general disease are already well developed in one or other, or in both, of these situations, at the time that they reveal themselves also on the side of the brain. In the latter, and by far the most common class of cases, the symptoms met with will be in part those of the general affection, and in part (but in a predominant degree) those due to that implication of the brain and its membranes with which we are now specially concerned. *See* Tuberculosis.

Ætiology.—The ætiology of tubercular meningitis of course resolves itself into the ætiology of the general disease, acute tuberculosis, of which it forms part.

This affection is one which occurs with special frequency in young children, between two and six years old, though it is also met with in infants, in older children, in young adults, and even in persons beyond middle age. In adults it is most apt to manifest itself as an occasional complication in the course of pulmonary phthisis. In children a proclivity to the disease seems often to be inherited, so that two or more in the same family may be carried off by it. But in what proportion of cases any such proclivity exists can scarcely be said to be known.

The central brain-changes—namely, the dropsy and the central softening—are not, in the opinion of the writer, necessary accompaniments of tubercular meningitis, although they most frequently coexist—just

as they are also most frequently concomitants of simple or non-tubercular meningitis when it affects the base of the brain. These central brain-changes were, however, the part of the disease that first attracted the attention of physicians, so that the affection with which we are now concerned was known as *acute hydrocephalus* long before the more modern designations of *granular* or *tubercular meningitis* came into use.

Anatomical Characters.—When the calvaria is removed, the dura mater is found to be tightly stretched over the brain; unless, as the writer has seen, the subject be an elderly person in whom some amount of senile wasting had previously occurred. On stripping back this membrane, the arachnoid presents a dull appearance, and it is slightly sticky when touched. The convolutions of the vertex and lateral regions of the brain are mostly seen to be more or less flattened from pressure, and the sulci are correspondingly indistinct. No lymph may be seen; or at most a small quantity, in the lower parietal regions, along some of the branches of the middle cerebral arteries. When the brain is removed, however, and its under surface is examined, a more or less opaque white or yellowish lymph-like matter may be seen, beneath the arachnoid, in the meshes of the pia mater, extending from the optic commissure backwards over the central portions of the base and onwards over the pons. In certain cases lymph and evidences of recent inflammation are found round the medulla, and even along the whole length of the spinal cord. More or less lymph also extends on each side into the Sylvian fissures. A minute inspection will likewise show that the tip of the temporo-sphenoidal lobe, and the orbital surface of the frontal lobe, are flecked with a number of translucent granulations, as though the parts had been sprinkled with fine sand; and on opening up the Sylvian fissure on each side, similar granulations, with others more opaque and of larger size, may be seen amongst the lymph in this situation. Translucent granulations also sometimes exist, scattered more sparingly over the lateral aspects of the hemispheres, especially along the sides of the vessels.

Examination with the microscope shows that the granulations are composed of overgrowths of tissue-elements immediately surrounding the smaller vessels, and within their perivascular sheaths. Within and among these cellular elements the *bacillus tuberculosis* is to be met with, though very sparingly. In these situations the tissue overgrowths may cause a local bulging of the sheath, either all round, or merely on one side of the vessel; and when such growths become opaque from incipient fatty degeneration, they are then more easily visible as minute white specks. A close examination of the prolongations of the pia mater dipping between the convolutions, with the aid of lens or microscope, will often show minute granulations not otherwise recognisable—and that, too, in many regions of the brain. And in cases of incipient tubercular meningitis, where the amount of lymph about the base is extremely slight, the lens or microscope may show the presence of granulations, not otherwise recognisable, in and around the lower part of the Sylvian fissures—that is, in the regions where they are most prone first to manifest themselves.

The pia mater is generally unduly adherent to the surface of the convolutions, so that it can only be removed in small shreds, and then not without tearing the superficial grey matter. This condition of things is the very opposite of what may be met with in some cases of simple meningitis affecting the vertex, in which the thickened pia mater, with all its prolongations, may sometimes be easily stripped off from the greater portion of a hemisphere in one piece.

The substance of the brain is commonly much more vascular than natural. The lateral ventricles are usually moderately dilated, containing from two to four or six ounces of not very clear serum. The veins on their surface are then engorged, and the fornix and other adjacent parts may be more or less softened, or actually diffluent. Microscopical examination of such softened tissue will reveal the presence of an abundance of granulation-corpuscles; and its specific gravity, if estimated, will be found to be diminished — both these characteristics being marks of a pathological softening which has occurred during life, and not of a softening due to mere *post-mortem* maceration. Some have erroneously supposed that such mere maceration has been adequate to produce the softening.

Sometimes the above-described changes are more fully developed in one than in the other hemisphere; and occasionally also in some parts of the brain small nodular growths of a 'tubercular' nature may be met with, varying in size from a small pea to an almond. These growths are most apt to occur in the substance of some of the cerebral convolutions, or near the surface of the cerebellum, or even, as the writer has seen, within the substance of the corpus striatum. In many such cases the small nodular tumours will be found to be in intimate relations with the vessels of the part, and, in fact, to be composed of a mere aggregate of the smaller 'granulations' more or less fused into a single mass.

Pathology.—The granulations begin to appear first in the meninges of the base under those irritative influences, whatever they may be, which lead to the development of similar grey granulations in other organs

of the body. These primary changes excite a common inflammation of the membranes around, and thus entail the production of the lymph, which covers the base of the brain, and extends on either side into the Sylvian fissures. Why the grey granulations should tend to develop first, and specially about the vessels at the base of the brain, cannot at present be explained.

This inflammation of the basal meninges also extends, by direct continuity of tissue, over and around the cerebral peduncles to the velum interpositum, and to the connective tissue at the upper and anterior extremity of the middle lobe of the cerebellum. In one or other situation, and often in both, the tissues are thickened by lymph. The writer has seen the velum interpositum thick and leather-like in consistence, and the venæ magnæ Galeni which run through it blocked by thrombosis; and this he believes to be an occasional cause of the central softening and dropsy previously referred to as component parts of the disease. In other cases, where no such thickening or thrombosis is to be detected, there is great swelling of the connective tissue, from development of lymph, opposite the termination of those great veins which return the blood from the surface of the ventricles and from the central parts of the brain—at the point, that is, where the veins of Galen empty themselves into the straight sinus.

In this way the very common association of the central ventricular changes with the basal meningitis may be accounted for, and also the occasional absence of such changes, in instances where the inflammation, apt to be set up through mere continuity of tissue, does not attain sufficient proportions to interfere with the return of blood, either through the veins of Galen, or from them into the straight sinus. It is of course possible that the central softening may also be favoured by an independent affection of the small vessels situated in the walls of the ventricles, and a development of granulations around them—though this has not hitherto been recognised. It is, however, well known that thrombosis is extremely apt to occur in those minute vessels in various parts of the brain which are enveloped by granulations—a fact that goes far to account for the extreme gravity of the symptoms in many cases of tubercular meningitis, in which naked-eye changes appear to be slight and altogether disproportionate in amount.

Symptoms.—The symptoms presented in different cases of tubercular meningitis often vary very widely from one another, although amongst them all there is an underlying bond of similarity. The variation may be easily understood from a consideration of the fact that such symptoms form part of those pertaining to a febrile affection characterised by other local manifestations, of varying importance in different cases; and also from the fact of the differences constantly met with in the relative and absolute development of the different kinds of changes encountered within the cranium itself in this disease—especially in regard to the amount of ventricular effusion and central softening existing in conjunction with the meningeal inflammation, which again itself varies much in intensity and in regard to the area involved in different cases.

It is, therefore, usual and most convenient to enumerate the possible signs and symptoms of this disease as they occur in three stages—artificial and often ill-marked from one another as they are—namely (1) those of the *invasion stage*; (2) those of the *developed disease*; and (3) those of its *closing phases*.

1. *Stage of invasion.*—Among the initial symptoms of tubercular meningitis may be mentioned obstinate and recurrent vomiting, often associated with constipation; coming on frequently after a period of previous malaise; and associated with fretfulness, slight wasting, indisposition to play, and disturbed sleep. Soon after, or simultaneously, there may be more or less marked indications of cephalalgia. Young children who cannot speak are fretful and constantly cry; they often also put their hands to their head. Such children start and cry out in their sleep. The temperature may be as yet scarcely, if at all, elevated; or there may be rigors from time to time, with temporary feverishness, recurring daily about the same hour. The child often cries out when touched, and a more or less general exalted sensibility to painful impressions seems to exist.

2. *Developed disease.* — In the second stage any feverishness that may have existed often abates. There may be less restlessness, so that the child even sleeps more than natural. The pupils are often insensitive to light, and unequal. There is frequently also some slight or perhaps marked strabismus. The pulse is apt to be much less frequent than natural (56–70 per minute perhaps), and decidedly irregular. The hypersensitiveness of skin may have disappeared, but a peculiar vaso-motor irritability exists, so that when the nail of the fore-finger is drawn once across the skin of the abdomen or other part, a deep red linear mark comes out slowly, and persists a long time. This so-called *tache cérébrale*, whilst also met with in other affections, is, as Trousseau rightly enough insisted, rarely absent in tubercular meningitis. Frequent plaintive cries may be uttered, though the child is generally more quiet and drowsy; it is apathetic also in regard to food, not asking or crying for it, but still taking it, perhaps well, whenever it is administered. Convulsions may occur during this stage, or weakness of one or

more limbs may be noticed, especially where larger tubercular nodules occur in certain regions of the brain-substance. Sometimes, however, the paralysis is of a shifting and transitory nature, varying in degree or even in situation in the course of a few days.

3. *Closing phases.*—In the closing stages of the disease the drowsiness may gradually deepen into stupor or actual coma; though in conditions short of the latter the child may still more or less frequently utter plaintive cries. The pulse, instead of being less frequent than natural, now becomes preternaturally frequent; whilst the respiration often assumes a slow, sighing, and markedly irregular type. The face, frequently pale and clammy, flushes at times. The head is hot, and the temperature generally raised, though often not more than to 100°, and rarely beyond 102°, until quite to the close of the disease. The fontanelle is raised, and there may be unnatural pulsation. The eyes, when examined with the ophthalmoscope, may show evidences of grey granulations in the choroid, and perhaps some amount of optic neuritis. The pupils may be unequal, but are generally dilated and insensitive. Occasionally the writer has seen a rhythmical contraction and dilatation go on, especially on exposing them to light. In this stage, when the patient is sufficiently conscious, it may be found that sight is notably impaired or almost lost.

The patient may take the food which is given, up to the last; though at other times there seems to be an actual inability to swallow it, even when it is placed in the mouth, owing to partial paralysis of the muscles of the tongue and pharynx. The abdomen is often boat-shaped and retracted; and an obstinate constipation still continues. Even in this last stage of the disease a temporary and delusive lull may take place; the child may seem to revive a little, but only too soon to lapse again into a state as bad as or even worse than before. Frequent and long-continued convulsive seizures are especially apt to occur during this stage of the disease; and death may take place during or immediately after one of these attacks. At other times the end is brought about more gradually, through progressing failure in the heart's action, combined with disturbance of respiration. In the latter class of cases the temperature may gradually fall, during the last few hours before death takes place, to several degrees below the normal; though in other cases of tubercular meningitis there is a slow and steady rise of temperature up to 105°, or even 106°, before the patient expires.

Diagnosis.—In the early stages the diagnosis of tubercular meningitis may present extreme difficulties. We must wait, before expressing a definite opinion in one of these doubtful cases, till the patient has been seen and examined two or three times. The premonitory symptoms and those of the first stage are often far from distinctive. They may, it is true, represent the beginning of tubercular meningitis, but, on the other hand, they may also represent something less serious—for instance, a mere failure of health from various causes, complicated by dentition, by some gastro-intestinal irritation, or perhaps the commencing outbreak of some one or other of the specific fevers. Details as to the child's condition during the last two or three weeks, comprising the order of evolution of the several symptoms, may, however, throw some important light upon the real nature of the case at an early stage of the disease.

A contributory cause of the difficulties besetting the early diagnosis of tubercular meningitis is to be found in the fact that acute tuberculosis is itself extremely difficult to recognise. We cannot, therefore, readily fall back upon a diagnosis of the general condition in order to strengthen our diagnosis of tubercular meningitis. As a matter of fact, it is just the reverse. Of all the local manifestations of this disease, those within the head produce by far the most definite set of symptoms; so that we can always most safely infer the probable existence of acute tuberculosis with grey granulations throughout the body, from the presence of the developed symptoms of tubercular meningitis. The symptoms produced by grey granulations within the thorax or within the abdomen are far less distinctive or, in fact, not distinctive at all. The existence of a particular habit or build of body in cases of acute tuberculosis to such an extent as to make it possible to use the recognition of it as an aid to diagnosis in a case otherwise obscure, is practically non-existent. Our notions as to the existence and nature of a tubercular habit of body need revision; it must not thoughtlessly be confounded with the mere phthisical habit of body; and it seems probable, from modern points of view, that acute tuberculosis is a quasi-accidental disease, occurring at times in individuals of any build of body whatsoever—with no more limitations, that is, than may exist in regard to the incidence upon persons of different bodily types of one of the common acute specific diseases.

The symptoms of the established disease are therefore alone distinctive, to any really trustworthy extent, of the existence of tubercular meningitis, and through it of the presence of its general underlying condition. We may have our suspicions before, but these can only transform themselves into certainties as the disease actually develops, and as it passes, moreover, into the incurable stage.

At this phasis of the disease the alternative conditions to be thought of are in the main these—typhoid fever on the one hand, or

else some form of intracranial disease other than tubercular meningitis. Here, as in almost all cases of brain-disease, we have to look not to any one or two signs or symptoms which can be regarded as pathognomonic, but rather to the sum total of symptoms, and to the way in which they are grouped. With the possible existence of some or all of the premonitory and initial symptoms already enumerated, if the patient becomes more somnolent; if the pulse falls much below par in frequency, and is at the same time irregular; if, with a condition of fever still existing, the child does not constantly crave for drink; and especially if there is also the combination of obstinate constipation and a retracted abdomen, together with an irregular and suspirious form of respiration—we may feel more and more certain that we have not to do with even one of the most anomalous forms of typhoid fever associated with head-symptoms—nor, indeed, with any form of intracranial disease other than tubercular meningitis. An examination of the temperature chart may considerably aid us in the same direction, and so also may a microscopical examination of the blood.

Some years ago, the writer made observations upon this latter point, tending to show that in tubercular meningitis there are, in a large proportion of the cases, distinctive alterations in the blood—as drawn by a needle-prick from the tip of the fore-finger and examined at once upon an ordinary microscope-slide—capable of affording very material aid in the diagnosis of tubercular meningitis from typhoid fever, as well as from other brain-affections (such as a new-growth implicating the pons and contiguous parts, thrombosis in some of the cranial sinuses, or perhaps one of the simple forms of meningitis). The characters of the blood met with in tubercular meningitis are these: The white corpuscles are decidedly more numerous than natural, and speedily (that is, within ten to fifteen minutes after the blood has been drawn) show signs of great amœboid activity, by the development of vacuoles within them, and of numerous projections from their outer surface; groups of protoplasmic particles of various sizes are also to be seen interspersed amongst the blood-corpuscles, as well as here and there a small pigment-granule or an irregular block of pigment of reddish or reddish-black colour. The red corpuscles usually run together into irregular masses, rather than into definite rouleaux, though they present no very distinctive changes. This increase in number with exalted amœboid activity of white corpuscles, in conjunction with the other blood-characters above-mentioned, are not met with in typhoid fever, or in the great majority, at least, of other cerebral affections.

For the diagnosis of tubercular from the simple form of meningitis, *see* MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.

PROGNOSIS.—Death is well-nigh certain within three weeks, or at most a month, from the date of the invasion-symptoms of tubercular meningitis. When the disease has arrived at a stage permitting of pretty certain diagnosis, hope rather than rational expectation may still hold out a chance of recovery. Although instances of this have occurred, they are of extreme rarity. If the course of the disease is to be modified by treatment, it must be during those early stages when we are capable of forming only a provisional or tentative diagnosis. In these stages, however, some good observers have hitherto been inclined to think that under judicious treatment the development of the disease may be arrested. This view may quite possibly, and even probably, be an erroneous one. Proof of such a position, or of its opposite, is, from the nature of the case, impossible.

TREATMENT.—From what has just been said, it will be seen that anything like curative treatment is only to be thought of in regard to the early or premonitory stage of the disease, or of conditions of health indistinguishable therefrom. Here the writer thinks he has seen decidedly good results from one to six grains of iodide of potassium, according to the age of the child, administered three times a day, with small doses of cod-liver oil; at the same time attending to the state of the bowels, and giving suitable doses of bromide of potassium at night, till the restless condition with disturbed sleep has passed away.

When the disease definitely declares itself or is further advanced, we may perhaps be able to diminish pain by the application of cold to the head; but we only aggravate the sufferings of the patient by the use of blisters, tartar emetic ointment, or other irritating applications, such as were often had recourse to by our predecessors. Bromide of potassium may do something to keep convulsions in check, though at other times it seems to be quite powerless, and drugs of this type should never be employed in later stages of tubercular meningitis, unless there is some strong indication for their use. Chloral hydrate, again, is probably a dangerous drug for a patient, the action of whose heart is already so seriously interfered with; though chloroform inhalations may be had recourse to in an extreme case where persistent convulsions cannot otherwise be checked. Beyond this, the child needs the most careful nursing, and to be well supported with strong beef-tea and milk, and occasionally with stimulants, so long as it is capable of taking food, whilst attention is paid to the bowels, which are often best relieved by means of enemata. In this way, if the patient's case is to prove one of those rare and exceptional instances in which re-

covery is possible, we at all events do nothing to thwart the course of natural processes which have a chance, however small, of terminating in recovery.

H. Charlton Bastian.

MENINGES, CEREBRAL, Hæmorrhage into.—Synon.: Fr. *Apoplexie Méningée*; *Hémorrhagie Méningée*; Ger. *Hirnhautblutungen*.

Definition.—Effusion of blood in one or other of the following situations: (1) Between the bone and the dura mater; (2) between the dura mater and the arachnoid (into the so-called ' arachnoid sac '); or (3) beneath the arachnoid and into the meshes of the pia mater.

Ætiology.—The first of these varieties of meningeal hæmorrhage has an almost exclusively traumatic origin; being a result of falls or blows which occasion the rupture of one of the meningeal arteries, lying between the bone and the dura mater. Still, caries of the bone may in very rare cases lead to such a hæmorrhage, by causing erosion of one of the meningeal arteries.

The other two varieties are not so distinctly separated from one another, since a hæmorrhage occurring in the pia mater, if large, is very apt to break through the arachnoid, and thus lead to effusion of blood into the ' arachnoid sac '; and this whether the primary effusion has been the result of a traumatic injury, or is a sequela of some general or local disease. Effusion into the arachnoid may also occur as a result of rupture of some vessel on the inner surface of the dura mater; this being probably a rare consequence of injury, though it is a frequent result of disease in this situation (*pachymeningitis interna*).

Effusions of blood are occasionally found beneath the arachnoid which have not originated there, but which have come to the surface, by laceration of brain-substance, from some intracerebral hæmorrhage; or they may have been caused by intraventricular hæmorrhages, finding their way into the fourth ventricle, and thence into the subarachnoid tissue of the pons and cerebellum.

In very young children, whose vessels are presumably healthy, bleeding into the arachnoid may occur from any unusual amount of strain. This occasionally takes place at the time of birth, especially during prolonged labours. Indeed, according to Cruveilhier, arachnoid hæmorrhage is the cause of the death of about one-third of those infants who die almost immediately after birth. The extreme frequency of these hæmorrhages in infants in cases in which the labour has been difficult or protracted has, moreover, of late been established by Dr. Herbert Spencer. A little later on in life, a similar accident may occur during paroxysms of whooping-cough, or during other spasmodic respiratory conditions, in which the return of venous blood from the head is impeded. Later still, an arachnoid hæmorrhage not infrequently follows a fall or blow upon the head, or it may result from the rupture of an aneurysm on one of the larger vessels about the base of the brain—especially the basilar or one of the middle cerebrals. Small subarachnoid hæmorrhages, often multiple, are not infrequently produced by the occurrence of thrombosis in the longitudinal sinus. They may also occur in persons suffering from scurvy or leucocythæmia. Lastly, they may be met with as one out of the many forms of lesion occurring in men suffering from general paralysis of the insane.

Meningeal hæmorrhages are decidedly more common in males than in females—in the proportion of about three to one. They do not, however, like cerebral hæmorrhages, occur with progressive frequency as age advances, but are much more uniformly distributed through the different decades of life.

Anatomical Characters.—When death takes place soon after blood has been effused into the arachnoid, as well as in the other situations, it is found in an easily recognisable condition. This is by no means the case, however, after the lapse of many months or even years; then, in the case of small hæmorrhages, we may meet with mere yellowish or rust-coloured stains; whilst where they have been of larger size, we may find decolorised cyst-like bodies, either free or adherent—or else there may be decolorised membranous masses, adhering mostly to the parietal arachnoid. Where the size of the clot has been large, the surface of the brain is more or less pressed upon, so that some atrophy of its substance follows. Many of these latter points are well exemplified in a case recorded by Sir Richard Quain in the *Path. Trans.*, vol. vi. p. 8.

Sometimes the layers of altered blood are neither adherent to the arachnoid, nor do they lie free on its surface; they may be attached to the surface of the dura mater, or lie between new-growths arising from its inner layers, and thus produce a condition which often goes by the name of *hæmatoma*. Prolonged discussions have taken place on the question whether these changes are results of a primary hæmorrhage, or whether we have not rather to do with a *pachymeningitis interna hæmorrhagica*, where an inflammation is the first event, during which effusion of blood takes place into the innermost layers of the altered and inflamed membrane. See Meninges, Cerebral, Hæmatoma of.

Symptoms.—The symptoms attendant upon meningeal hæmorrhage will necessarily vary a great deal in severity, according to the amount and suddenness of the effusion. These symptoms are, moreover, in the great majority of the traumatic cases obscured

by those depending upon the mere shock and concussion of the brain, which the original accident or blow occasions.

Where subarachnoid hæmorrhages occur in the course of thrombosis of the longitudinal sinus, no distinctive symptoms are as a rule produced; and those of the primary affection are themselves only too variable, and difficult of recognition. Again, where subarachnoid hæmorrhages occur in the course of purpura, leucocythæmia, or allied affections, the amount of blood effused is usually too small to produce definite or recognisable symptoms. At most, the abrupt onset of pain in the head, vertigo, or mental confusion, may give rise to a suspicion that such an event has occurred.

Where a large hæmorrhage takes place beneath and into the arachnoid sac, over one hemisphere, or over both, either as the result of a fall or blow, or from the bursting of an aneurysm on one of the large arteries at the base of the brain, a profound coma is produced which may prove rapidly fatal—that is, in the course of a few minutes or a few hours. Where the amount of blood effused is less, and where it is poured out more gradually at first, there may be premonitory symptoms, in the form of sudden headache, vertigo, mental confusion, vomiting, or convulsions, rapidly followed by unconsciousness. At first there is generally complete relaxation of all the limbs; but later—after some hours or days—the weakness may be distinctly unilateral, that is, of hemiplegic type—though sometimes with very slight implication of the face. There may also be twitchings or rigidity of the limbs on one or both sides. On recovery of consciousness there may be no distinct loss of sensibility, only numbness, in the limbs; and the paralysis may after a time grow less up to a certain point, or gradually disappear.

Diagnosis.—In many of the slighter forms of hæmorrhage into the cerebral meninges diagnosis is, for the reasons specified, almost impossible.

In the more severe cases a sudden apoplectic attack is produced, agreeing very closely with that occasioned by some of the most serious forms of intracerebral hæmorrhage. Causal conditions, especially when they have been traumatic, together with the possible youth of the patient, may in some cases help us to diagnose a large arachnoid hæmorrhage from a copious bleeding into the lateral ventricles, or from a sudden hæmorrhage into the middle of the pons Varolii; though it should be borne in mind that in the former of these two conditions the pupils are almost always widely dilated, whilst in the latter they are as constantly contracted and insensitive; whereas they are likely, so far as the writer's observations have gone, to be in a more intermediate condition in arachnoid hæmorrhage.

Prognosis.—In the case of arachnoid hæmorrhages, whether large or of only moderate volume, should the patient survive the first effects of the effusion (and, it may be, of the injury which caused it), danger to life is no longer to be feared. The only question then is as to the amount of paralysis, mental impairment, or of irritability with cephalalgia, which may remain; or whether or not a tendency to convulsions may be set up, as a consequence of the original injury and lesion.

Treatment.—The treatment of a case of meningeal hæmorrhage does not differ from that appropriate for cerebral hæmorrhage. Perfect rest in the recumbent position, with the head slightly raised, is essential. Cold to the head may be conjoined with hot applications and mustard plasters to the lower extremities. For other indications and details of treatment we must be guided by the varying conditions of the patient. In some cases (especially where the hæmorrhage has been between the dura mater and the bone) the aid of the surgeon has been sought, who, by trephining and giving exit to much of the extravasated blood, has either cured or greatly mitigated the condition of the patient. During convalescence, in the more favourable cases, we must pay great attention to the general health, and above all protect the patient from overwork or excitement of any kind. H. Charlton Bastian.

MENINGES, CEREBRAL, Hæmatoma of.—Synon.: *Pachymeningitis Interna Hæmorrhagica*; Fr. *Pachyméningite*; Ger. *Pachymeningitis*.

Definition.—Inflammation of the inner surface of the dura mater, attended with the formation of a membranous vascular tissue, into which hæmorrhage takes place.

Ætiology.—This affection is met with at all ages, but is most common in advanced life and early childhood. Males are said to suffer more frequently than females. It is rarely primary; most of the recorded cases have followed, at some interval, an injury, or occurred in the subjects of insanity or chronic alcoholism. Other cases have appeared consequent on acute rheumatism and other pyrexial affections, especially pneumonia and small-pox.

Anatomical Characters.—According to Virchow, in the early stage, before hæmorrhage has taken place, a delicate reticulated membrane exists on the inner surface of the dura mater in one or many layers—even as many as twenty. It varies in consistence according to its age. The colour is usually reddish, from the number of new-formed vessels; but it is often rust-coloured from degenerated blood extravasated in minute quantity. The position of the membrane is always over the convexity, commonly near the middle line; and it is often symmetrical

on the two sides. In the second stage, that of hæmorrhage, blood in considerable quantity is effused between the layers in one or several places, and may extend as far as the limits of the false membrane, thus constituting one or more simple or loculated cysts. These cysts are, of course, adherent externally to the dura mater, and internally rest on the arachnoid membrane and convolutions, which they compress and even depress. Their contents are blood — liquid, coagulated, or in every stage of degeneration. Ultimately only coloured serosity may remain. The thin delicate wall of the cyst was formerly regarded as organised fibrin from a blood-clot, or as the separated parietal layer of the arachnoid; and some pathologists are still of opinion that the hæmorrhage precedes the formation of the membrane. *See* MENINGES, CEREBRAL, Hæmorrhage into.

SYMPTOMS.—Two periods may often be recognised, corresponding to the anatomical stages of hæmatoma of the dura mater just described. In the first, circumscribed headache is the chief symptom, often felt at the vertex. It may be associated with giddiness, uncertainty of movement, lowered mental power, and contraction of pupils. In children, in whom the whole disease commonly lasts only a few days, there is often fever. In adults this stage may last for weeks or months. The second stage, that of blood-effusion, is attended by an increase of the mental dulness to distinct somnolence, at first intermitting, but deepening to actual coma with a rapidity that depends on the rapidity of effusion. The pupils continue contracted, but that on the side of the mischief may become the smaller. Hemiplegic paralysis or contraction may occur when the hæmatoma is unilateral. In children convulsions are common. The duration of this stage in the adult may be weeks or months; and death occurs in coma. In children it usually lasts only a few days.

DIAGNOSIS.—The diagnosis of hæmatoma of the dura mater is often difficult, and depends on the slow onset of coma after a period of headache, without symptoms to indicate a localised lesion of the brain. In the child the disease may be mistaken for tubercular meningitis, but the course of infantile hæmatoma is usually more rapid, vomiting is rare, and muscular contractions and convulsions are common.

PROGNOSIS.—The prognosis is very unfavourable, but not absolutely fatal in the adult; in several cases in which the symptoms of hæmatoma have been present, recovery has taken place. In children there is little hope.

TREATMENT. — In the child one or two leeches may be applied behind the ears; and cold to the head, and counter-irritation to the skin of the neck and limbs, are likely to be useful.

In the adult, if by rest, cold to the head, and counter-irritation the effusion can be arrested, absorption of the blood will slowly take place; and this may be furthered by moderate purgation, by diuresis, as well as, perhaps, by the administration of mercury or iodide of potassium. W. R. GOWERS.

MENINGES, CEREBRAL, New-Growths and Adventitious Products in.—The clinical aspects of the several pathological conditions composing the set of changes included under these heads are comparatively meagre and ill-defined, as compared with what we know of them pathologically. For this various reasons exist, some of which will now be indicated.

SYMPTOMS AND DIAGNOSIS.—Intracranial new-growths or adventitious products are, as a class, accompanied by the most diverse sets of symptoms. The new-growths or products vary in different cases within very wide limits, from the point of view of the suddenness of their onset or increase, as well as of their actual bulk or number, and also as regards the particular intracranial region or regions which they implicate. We may therefore in some measure understand how it happens that some growths or products may be unaccompanied by appreciable symptoms during life; that others may be associated only with vague symptoms of a general order, denoting the existence of some kind of intracranial mischief; whilst, on the other hand, some may be associated with such comparatively definite groups of symptoms as to make it reasonably easy to arrive at a pretty certain diagnosis, both as to the situation and as to the nature of the intracranial growth or morbid product.

But, it may be said, why use the broader term 'intracranial' when we are here only concerned with morbid conditions of the meninges? This brings us to the last source of variation above referred to, namely, that dependent upon differences in locality. But, great as this cause of variation is, it must be clearly understood that it is for the most part impossible to distinguish clinically between mere meningeal new-growths or products, and those which arise from or within related portions of the encephalon. The reasons for our impotency in this direction are also not difficult to find. First, we may cite the general one, of the frequent vagueness or even absence of any appreciable symptoms attendant upon intracranial growths or products, whether they be of meningeal or of intracerebral origin; and, secondly, the more special reason, that growths starting from the meninges will often press upon and implicate the surface of the brain in different regions, in much the same manner as if they sprang from the surface of the brain itself in such regions. And, thirdly, there is the further consideration that intra-

cranial growths or products are frequently multiple in the same individual, and then may partly spring from the meninges, and partly from the substance of the brain itself.

For these various reasons it happens that if the diagnosis of a purely meningeal new-growth or adventitious product could ever be arrived at, it would have to be effected through the medium of a previous pathological diagnosis. But how limited are the possibilities in this direction may be gathered from the following considerations. Certain personal or family characteristics presented by a patient may make it highly probable that syphilitic intracranial disease, or that scrofulous intracranial growths exist. Still more rarely the signs and symptoms may indicate that cancerous intracranial growths, or that growths similar to some multiple tumours already existing in other parts of the body, may be the causes also of coexisting head-symptoms. Yet these are almost the only cases in which it may be possible for us to arrive at anything like a positive diagnosis as to the nature of a supposed intracranial growth or product. And of these the first only, namely, syphilitic disease, could with any degree of certainty be diagnosed as a change limited to the meninges ; the others would be just as likely to take origin within the cerebral substance as from the meninges.

For these reasons no good purpose would be attained by entering at length into the groups of symptoms that may be produced by meningeal growths or adventitious products. They are apt closely to resemble some of those coexisting with growths within the brain. *See* BRAIN, Tumours and New-Growths of.

ANATOMICAL CHARACTERS.—It will suffice to indicate briefly the nature of the morbid changes which are included in this article.

A. **New - Growths.** — (*a*) *Syphilitic growths or thickenings of the meninges.*— These products are met with principally in the form of yellowish lymph-like masses, connecting the dura mater with the arachnoid, and this, along with the pia mater, to the surface of the cerebral hemispheres in some region (often the parietal), of irregular area and variable extent. This yellow 'gummatous' material probably takes its origin, for the most part, in or on the surface of the dura mater, while it may extend inwardly so as to infiltrate or press upon the surface of the brain, and also outwardly so as to cause erosion of the cranial bones. The membranes around may be thickened, or more or less obviously inflamed. This form of disease does not occur in congenital syphilis ; when it exists, therefore, it is invariably met with in persons beyond the age of puberty. Similar growths taking origin completely within the brain-substance are extremely rare.

(*b*) *Scrofulous tumours.*—These are now mostly spoken of as 'tubercular' growths. They, unlike the last, are much more frequently met with in children than in adults, and especially in young children between the ages of two and seven years. They are yellowish nodular masses, varying in size from that of a small pea to a walnut. While some of them may obviously spring from the pia mater, others (and this much more frequently) are met with within the substance of some portion of the cerebrum or cerebellum. As in the last case, these growths are presumed to be dependent upon the existence of a special constitutional state—one which carries with it proclivities to certain kinds of tissue overgrowth.

(*c*) *Cancer.* — Cancer not infrequently affects the dura mater, whence it may extend outwards or inwards, and thus implicate other parts secondarily—either eroding and perforating the bone, or greatly depressing or infiltrating the surface of the brain as it grows inwards. Although more frequent in the second half of life, meningeal cancer may occur also in youth, or even in childhood.

(*d*) *Other growths.*—Other growths of less frequent occurrence, and therefore of less importance, also start from the meninges. We may have the following: *sarcomata*; *fibromata* ; *fibro-enchondromata* ; *steatomatous or cholesteatomatous growths* ; and *structureless or wax-like tumours*, having the so-called 'amyloid' reaction. Such tumours as these may give rise to more or less definite head-symptoms during life. They spring, for the most part, from the dura mater rather than from the arachnoid.

Other smaller, and mostly rare, growths may be met with quite unexpectedly after death, because of their occurrence in the form of flat plates, which do not interfere by pressure or otherwise with the subjacent cerebral substance, and therefore give rise to no obvious symptoms. They are : *osteomata*, which occur either in the falx, in the walls of the lateral sinuses, or much more rarely in the substance of the arachnoid, in the form of osseous plaques; and *calcareous depositions* (belonging, perhaps, more strictly to the next than to this section), which vary in size from a mustard seed to a small nut, and which may be found in or beneath the arachnoid, or also on the inner surface of the dura mater. Sometimes a number of such minute concretions may be met with in connexion with the pia mater or arachnoid (especially when these membranes are thickened or otherwise diseased), in the form of minute granules closely resembling the so-called 'brain sand,' each of which may present traces of several concentric layers.

B. **Adventitious Products.**—(*a*) *Parasites.*—These may be of two kinds, both of them being larval states of tape-worms.

Cysticerci are larval conditions of *tænia solium*, having the form of small bladders, which vary in size from that of a pea to a

horse-bean. They often exist in large numbers in the meninges and within the brain of the same individual, and are very rarely solitary. As many as one hundred may be found within the cranium; and when they are thus numerous, many of them will almost certainly be met with in the pia mater, merely pressing upon and slightly indenting the surface of the convolutions, though others will be situated within the substance of both cerebral and cerebellar convolutions. They are not confined to persons of any particular age or either sex, though they occur rather more frequently in those representing the second than the first half of life. Infection is brought about by unclean habits in those who are affected with either of the two common forms of tape-worm, or occasionally by ripe proglottides getting into the stomachs of such persons during acts of vomiting. In such a case the contained ova would be liberated, and the embryos developed therefrom disseminated through the body of the host. *See* Entozoa.

Hydatids which are met with in the brain are always barren cysts (acephalocysts), and the outer enclosing membrane is generally very thin. They are usually solitary; may vary in size from that of a marble up to a large orange; are rare even in the brain-substance, and still more rare in the pia mater. Sometimes two, three, or more hydatid cysts exist within the cranium of the same individual, but they are then usually of small size. Davaine refers to an instance in which many hydatids were found in the meninges and at the surface of the brain, as well as within its substance. Out of twenty-four recorded cases, in which the age was stated, the writer has found that no less than eighteen of them were persons between the ages of ten and thirty years, three of the remainder being above and three below these extremes. Infection may well be brought about by means of the dog's tongue, which is at times only too quickly transferred from parts liable to be contaminated by ova of its own tape-worms, to the hands or even the lips of his master or mistress. Besides this more direct method, the ova of the tænia echinococcus voided by the dog may be blown about, or otherwise get by accidental means into water or food taken by man. *See* Entozoa.

(*b*) *Aneurysms.*—These, situated either on one of the vessels composing the circle of Willis, or on some one or more of its primary branches, may vary in size from a small pea to that of a walnut. Those of the larger sizes, which are usually single, may give rise to distinct head-symptoms; but at other times, and especially when the aneurysm is very small, there may have been no reason to suspect its existence, or that of any other intracranial disease, till perhaps the rupture of such an aneurysm may lead to the supervention of serious symptoms, speedily terminating in death. These aneurysms may occur, possibly as a sequence of a previous embolism (Church), even in early youth as well as in adult age.

(*c*) *Thrombi in the cerebral sinuses.*—The process of thrombosis is known principally as it occurs in three of the sinuses contained within the cerebral meninges, namely, in the longitudinal sinus, or in one or other of the two lateral sinuses.

(1) The formation of a thrombus in the *longitudinal* sinus is usually a *primary* phenomenon, dependent in the main upon the operation of general causes, such as some alteration in the quality of the blood, combined with slow, feeble, and irregular action of the heart. The operation of these causes has, however, been known to have been favoured in certain cases by local conditions, such as the great development of Pacchionian bodies, and their projection into the sinus—an event most likely to occur in elderly persons. Thrombosis of the longitudinal sinus may, however, be met with also in the early as well as in the middle periods of life. The original thrombus frequently prolongs itself through the straight sinus to the torcular Herophili, and thence on either side into the lateral sinuses. And in this latter class of cases ventricular effusions and superficial cerebral softenings are apt to be associated with the thrombosis. The softenings are of a peculiar and characteristic kind, consisting generally of a number of small red patches, occupying principally the grey matter on each side of the upper surface of the brain. Occasionally softening of a portion of brain of considerable extent has been produced. Besides the ventricular effusion, there may also be an excess of serum beneath the arachnoid, or more rarely small effusions of blood in these situations, together with minute patches of hæmorrhage in the convolutional grey matter, such as have been described by Cruveilhier under the name of *apoplexie capillaire*. The actual combination of these conditions will depend upon the seat of the obstruction, the rapidity with which it is brought about, and the existence or not of marked pathological conditions of the vessels generally. The variation in the symptomatology of this affection in different cases is, therefore, also extreme; the symptoms are sometimes of an excessively grave order, and sometimes almost *nil*. Strange as it may seem, Dr. Gee says: 'I have known a decolorised softening thrombus to occupy the whole bore of the upper longitudinal sinus, to be attended by large subarachnoid hæmorrhages, and to have caused no symptoms during life.'

(2) Just as frequent, however, as the event above referred to, is the formation of a thrombus in one or other of the *lateral* sinuses; only then the process is almost

invariably *secondary* to inflammation of the scalp or cranial bones, whether induced by traumatic conditions or by disease. Caries of the cranial bones is the principal predisposing condition; indeed, in three-fourths of the recorded cases the temporal bone was the part affected, and that as a result of internal otitis. In these cases there is often evidence of a more or less circumscribed inflammation of the meninges, but cerebral softenings and subarachnoid extravasations of blood rarely occur. This, according to von Dusch, is explicable by the fact that in such cases the thrombosis starts from the veins in communication with the inflamed spot, and reaches the lateral sinus only after the collateral circulation has had time to establish itself; instead of forming primarily in the sinus, and before a collateral circulation has been set up.

(*d*) *Serum.*—This fluid may be met with in excess in two situations. It occurs (1) *beneath* the arachnoid, in cases in which one or both cerebral hemispheres have become wasted or atrophied. After fifty or sixty years of age, therefore, it is common to find an excess of subarachnoid serum. This fluid transudes from the vessels as pressure outside them diminishes, owing to brain-atrophy. It is absurd to suppose that it has any other, or at least any important, pathological significance. To speak, as some do, of 'serous apoplexy' as a cause of death, when no very obvious reason for the death can by such persons be assigned, is a mischievous assumption of knowledge where a confession of ignorance would be better. But serum is sometimes found in excess (2) *within* the cavity of the arachnoid, when it constitutes the condition occasionally spoken of as 'external hydrocephalus.' It seems probable that the majority of such cases are instances in which the fluid of an ordinary internal hydrocephalus has, at some period before or after death, in part escaped from the ventricles into the cavity of the arachnoid (*see* Hydrocephalus, Chronic). Still, there may be a narrow margin of cases not capable of being thus accounted for, in which the cause of the presence of fluid in this situation is very uncertain, when it is not, as it may sometimes be, an appanage of meningeal inflammation.

Prognosis.—Some of the smaller and more slowly growing tumours may give rise to no very obvious symptoms during life, and may not appreciably tend to shorten its duration. Again, the accumulation of serum beneath the arachnoid is only a non-disturbing effect of other causes.

The case is, however, of much graver import where we have to do with syphilitic, scrofulous, cancerous, or other growths having a tendency to more or less rapid increase; also where the patient is suffering from the existence of intracranial cysticerci or hydatids, or from the occurrence of thrombosis in the longitudinal or lateral sinuses. In all such instances we may, for the most part, look for a steady increase in the gravity of the patient's symptoms, and (except in the case of the first kind of growth under the influence of proper treatment) for death at no very distant date.

Treatment.—Drug treatment can be looked forward to as curative, or nearly so, in only one of these various maladies, namely, in that of syphilitic origin—hence the great importance of a correct diagnosis where this condition is present. In a large number of cases, symptoms of the gravest character, associated, it may be, with paralysis, stupor, severe convulsions, excruciating cephalalgia, and even incipient insanity, one or more, or all, will, when really of syphilitic origin, yield in a truly marvellous manner to the continued and steady use of iodide of potassium in doses of eight grains, gradually raised to twenty or thirty grains, three times a day, especially when given in combination with $\frac{1}{32}$ to $\frac{1}{16}$ of a grain of bichloride of mercury.

Cod-liver oil, with steel wine or the syrup of phosphate of iron, together with good food, quietude, and fresh air, may also do something to retard or even stop the growth of scrofulous tumours in sickly children.

Beyond this, in the class of cases which we have just been considering, medicinal treatment can be merely palliative. We must strive to relieve headache and secure better sleep; to mitigate the severity of convulsive attacks; or, if possible, to lessen the marked tendency to vomiting which may exist. Mental dulness and stupor, in such cases, are mostly beyond the reach of relief from therapeutics; though restlessness and irritability may perhaps be mitigated, by the administration of remedies suitable for the relief of pain, and for the encouragement of sleep.

In certain cases of meningeal tumour, as in tumours which involve the cortex of the brain (and especially in both kinds of growth when they are in relation with the 'excitable area,' and therefore capable of being accurately localised), the question of the propriety or not of a surgical operation for its removal should be entertained. In some instances such a procedure holds out the only definite chance of curing or notably relieving the patient.

H. Charlton Bastian.

MENINGES, SPINAL, Diseases of. The following conditions of the spinal meninges have to be considered:—

1. *Inflammation* of several varieties.
2. *Hæmorrhage.*
3. *New-growths* and *Adventitious products.*
4. *Malformations.* See Spina Bifida.

Inflammation affects the spinal meninges in several different forms, though they are

divisible into two main categories. Thus we may have: (*a*) *Inflammation* of the spinal meninges of *traumatic* or *secondary* origin; and affecting either the dura mater (*spinal pachymeningitis*); or the arachnoid membrane (*spinal arachnitis*). (*b*) *Inflammation* of the spinal meninges of a *simple idiopathic*, or of a *tubercular* nature, and both affecting the pia mater (*spinal leptomeningitis*).

These different forms of spinal meningitis, whether existing alone or in association with a similar inflammation of the cerebral meninges, occur as acute diseases. Occasionally, where such diseases do not terminate fatally, they may lapse into a subacute or chronic condition, and thus persist for a considerable time. In association with new-growths or with adventitious products in the meninges, there may also arise a subacute or chronic localised inflammation of these membranes; but of chronic spinal meningitis beginning idiopathically as such, and pursuing a course chronic from the first, our knowledge is at present extremely slight. Chronic thickenings of the spinal membranes are, it is true, met with from time to time *post mortem*, which are by some deemed to have had an inflammatory origin independently of any acute attack. But as in other situations, so here, considerable thickenings of these serous membranes may be met with as a result of degenerative rather than of inflammatory changes; and such conditions may give rise to no very appreciable symptoms during life till, as a sequence of their thickening and undue adhesion to the surface of the spinal cord, a superficial or annular form of sclerosis becomes established in this organ, either limited in site or irregularly developed in different regions.

H. Charlton Bastian.

MENINGES, SPINAL, Inflammation of, Traumatic and Secondary.—Ætiology.—In the case of the cerebral meninges, inflammation as a result of traumatic injuries is more common than as a phenomenon secondary to disease of the bone or of the scalp. The proportional frequency of these modes of causation is, however, somewhat reversed in the case of the spinal meninges; partly because the head is more liable than the spine to suffer from direct injuries, and partly because disease of the spine and of adjacent parts occurs with considerable frequency in such a manner as to be capable of exciting a secondary inflammation of the spinal meninges. Among the various efficient *traumatic* influences may be mentioned fractures and dislocations of the vertebræ, and stabs or other penetrating wounds implicating the contents of the spinal canal; while among the most frequent morbid conditions, in the course of which there may be a *secondary* development of spinal meningitis, we must cite the following: Caries and tubercular disease of the vertebræ; syphilitic gummata; deep sloughing bed-sores in the sacral region; cancer of the vertebræ; and, more rarely, inflammation of some part of the thoracic or abdominal parietes contiguous to the spinal column, and capable of spreading to the spinal canal from within.

Anatomical Characters.—In all these cases the signs and products of inflammation may be found in one or other, or in both, of two situations; that is, either implicating the dura mater, principally on its external surface, when we have the condition commonly known as *spinal pachymeningitis*; or affecting the surface of the arachnoid so as to produce a *spinal arachnitis*. Thus the same kind of limitation in the distribution of the inflammation is apt to occur when it starts under the influence of such causes as is found to obtain in regard to the traumatic or secondary inflammations of the cerebral meninges. Perhaps there is in the case of inflammation of the spinal membranes, however, a rather more distinct tendency for such inflammations to spread, so as to involve the subjacent pia mater, than is the case in the parallel inflammations of the cerebral meninges.

In *spinal pachymeningitis* the dura mater itself is thickened and more vascular than natural, this being seen more especially on its outer surface; and both it and the surrounding connective tissue are covered or infiltrated either with yellowish lymph-like matter, or with actual pus. The internal surface of the dura mater may also be more or less covered with inflammatory products. The nerve-roots passing through the membrane are likewise generally affected by the inflammatory process, and they may show signs of compression or even of atrophy. Such inflammation may be either limited to the region of two or three vertebræ, or it may affect more or less the whole length of the spinal membranes.

Another more idiopathic and also more chronic form of spinal pachymeningitis has been observed by Charcot and others, affecting principally the inner layers of the dura mater in the cervical region. In this condition, which is described by the author above named as *pachyméningite cervicale hypertrophique*, there seems to be a considerable hyperplasia of tissue-elements in the inner layers of the dura mater, which is apt to develop into an overgrowth of almost cicatricial hardness, often made up of concentric laminæ. These are frequently adherent to the arachnoid and to the pia mater, which also become more or less thickened. In these latter cases, especially, not only are the spinal nerve-roots greatly damaged, but the spinal cord is itself more or less compressed and softened, so that distinct paralytic

symptoms, with muscular rigidities or atrophy, are apt to be produced.

Where *spinal arachnitis* is superadded, or when it exists alone, we find that pus or lymph is situated on the outer surface of the visceral arachnoid, and also to a less extent on that lining the dura mater. The combination of the two conditions is rather more frequent than the existence of arachnitis alone. It is important to remember that all these forms of inflammation are very rarely, if ever, primary and idiopathic (with the exception of the more chronic variety described by Charcot), but that they occur as consequences of injury, or of certain forms of disease adjacent to the spinal canal.

SYMPTOMS, PROGNOSIS, AND TREATMENT.—As the nerve-roots are affected in these forms of inflammation, as well as in the idiopathic meningitis which implicates the pia mater (*spinal leptomeningitis*), and as the symptoms of both sets of affections are in great part dependent upon this, and are therefore in many respects similar (and by no means always capable of being accurately discriminated from one another), it would serve no useful purpose to dwell upon the symptomatology and treatment of spinal pachymeningitis and arachnitis alone. The reader is, therefore, referred to the corresponding sections in the next article.

H. CHARLTON BASTIAN.

MENINGES, SPINAL, Inflammation of, Simple Idiopathic and Tubercular.—SYNON.: Simple and Tubercular Spinal Leptomeningitis.

Simple spinal meningitis of idiopathic origin, and tubercular spinal meningitis, are affections so closely related to one another, both in their clinical and pathological aspects, that no advantage whatsoever would be derived from considering them separately. In each case we have to do with an inflammation involving the spinal pia mater, so that the products of inflammation are situated beneath the arachnoid membrane. In order to distinguish these from other forms of meningitis, such as pachymeningitis and arachnitis, it is desirable that we should use some special term, such as *leptomeningitis*, which is now employed as a distinctive appellation for an inflammation affecting the pia mater, whether cerebral or spinal.

In regard to the extent or area of this kind of inflammation, it must be said that the tubercular variety always involves the presence of a similar inflammation at the base of the brain, though the contrary position is not true—that is to say, the tubercular inflammation may exist at the base of the brain alone, without involving the spinal meninges. Of the non-tubercular forms of spinal leptomeningitis, there are two varieties, and of these one form always involves the membranes at the base of the brain and the spinal meninges simultaneously (*see* CEREBRO-SPINAL FEVER). The other form may or may not simultaneously involve the membranes at the base of the brain, so that we have in these cases either a 'simple sporadic cerebro-spinal meningitis,' or a 'simple spinal meningitis.'

Whenever the inflammation has a 'cerebro-spinal' distribution, no confusion is involved by retaining the use of the simpler term 'meningitis,' as it is generally understood that forms of inflammation having such a distribution involve the pia mater especially. But in place of the name 'spinal meningitis,' if we mean to imply that the inflammation affects the same tissue, it is best to use the more special and distinctive term 'spinal leptomeningitis.'

From what has been said above, it will be understood that the symptoms resulting from meningitis involving the base of the brain alone, or together with serous effusion and softening of the walls of the ventricles (which, as we have seen, so frequently coexists with inflammation of the membranes in this situation), have been principally studied in the purely cerebral forms of tubercular meningitis. On the other hand, the symptoms resulting from spinal leptomeningitis are best studied in the simple forms of this disease. It will also be evident that the simple and the tubercular forms of cerebro-spinal meningitis are likely to agree to some extent in their symptomatology with that of the disease known as 'epidemic cerebro-spinal meningitis.'

ÆTIOLOGY.—Spinal leptomeningitis is most prone to occur in children and in young persons; and is more frequent in males than in females. Persons who are badly fed, and live under very unfavourable sanitary conditions, are more liable to be attacked than those who are healthy and surrounded by opposite conditions.

For the tubercular form the exciting causes are all such influences or conditions, whatever they may be, as determine the outbreak of acute tuberculosis. The affection of the spinal meninges may be either an extension of the inflammation originally existing at the base of the brain alone, or it may be another independent manifestation of the general disease developing within the spinal canal simultaneously with the cerebral meningitis. *See* MENINGES, CEREBRAL, Inflammation of, Tubercular.

For the simple or non-tubercular form, the exciting causes are various, but the best established of them would seem to be these: Exposure to cold, or cold and wet, in various forms; certain acute diseases, or the period of convalescence therefrom; concussion of the spine, as from falling down stairs, or in other ways; wounds affecting the spinal cord or its membranes, as in stabs of various

kinds; or fracture and dislocation of the vertebræ.

The last modes of causation mentioned are similar to those which obtain for spinal pachymeningitis and arachnitis. For, although these latter conditions may be excited alone under such traumatic influences, they may also in certain cases, and especially arachnitis, be excited in association with a spinal leptomeningitis. Precisely the same kind of thing has also to be said in regard to the occasional action of other causes, such as caries of the vertebræ, deep-sloughing bed-sores in cases of paraplegia, or other instances of inflammatory processes contiguous to the spinal canal. Any of these latter conditions may also set up a leptomeningitis, in association with one of the other forms of meningeal inflammation.

A spinal leptomeningitis may spread so as to implicate the base of the brain; or a cerebral basal leptomeningitis may subsequently implicate the spinal membranes; or, lastly, the inflammation may appear in both regions simultaneously, and thus be from the first cerebro-spinal in seat. The writer has of late seen several cases of the tubercular variety belonging apparently to this latter category; but until the spinal canal has been regularly opened for some time in necropsies of persons dying from this disease, we shall be unable to say what is the exact numerical proportion of such cases as compared with those which are simply cerebral in type. The bulb may be comparatively free from lymph, and yet an inflammation of the spinal meninges may be well-marked. There must, therefore, be a routine opening of the spinal canal for the decision of this question, and not a mere casual inspection of its upper extremity through the foramen magnum.

Anatomical Characters.—According to the stage of the disease at which death takes place, we may meet with the inflammatory process in one or other of three different stages: (1) that of greatly increased vascularity of the spinal pia mater; (2) one in which, in addition to the increased vascularity, gelatinous serum, lymph, or pus exists in the meshes of the pia mater, and often more marked in amount along the posterior columns. This latter is the condition commonly met with; but in rare cases, where patients have survived an acute attack, we may find (3) certain residuary chronic changes in the form of thickenings, opacities, and undue adhesions of the pia and arachnoid to the spinal cord, which perhaps may itself show a more or less marked condition of peripheral sclerosis.

In the tubercular variety we frequently have to do with a more gelatinous serum, or thin greenish-yellow lymph (similar to that met with at the base of the brain), rather than with actual pus, in the meshes of the pia mater. Careful scrutiny of the vessels in the anterior fissure and in other parts may also show the characteristic 'granulations,' in the form of opalescent, whitish, or yellowish-white specks.

In both forms of the disease the *nerve-roots* are implicated in various ways. They are usually involved in the inflammatory process, and may be much pressed upon by lymph and other hyperplasic products. The nutrition of the cord itself is probably profoundly altered, owing to the existence of an inflammatory process affecting the network of vessels from which its blood-supply is derived; and, moreover, the organic continuity existing between the pia mater and the offshoots of connective tissue which extend into it on all sides, around the blood-vessels that penetrate its substance, makes it only natural to suppose that the inflammatory process would more or less invade the substance of the cord itself. And this, as the observations of F. Schultze have shown (*Berlin. Klin. Wochenschrift*, 1876, No. 1), actually does occur. But further researches are needed in this direction, in order that we may know the frequency with which grave changes of this kind are produced.

Symptoms.—General listlessness and a sense of chilliness have been noticed as premonitory symptoms in some cases of spinal meningitis. At other times the disease has been observed to commence with a more marked feeling of chilliness, accompanied or quickly followed by some febrile elevation of temperature, together with a full, rapid pulse. Soon there supervenes a deep-seated, boring pain in the back, varying in situation according to the degree of intensity of the inflammatory process at different levels. Pains may also extend round the body in girdle fashion, and likewise into the limbs. Whilst the pains in the back are more or less continuous, though greatly aggravated by all attempts at movement, those felt in the limbs and trunk may be only experienced when attempts to move are made. Movement excites the dorsal pain far more than pressure upon the vertebral spines, or light tapping over the same region.

Rigidity of the spine, from muscular spasm, either localised or general, and also rigidity of the limbs, or even of special muscles, may coexist with the pains in the back and limbs. There is often an exaltation of reflex movements in the early stages of the disease, though this condition is nothing like so well marked as it is in tetanus.

At the same time marked hyperæsthesia of the skin exists over considerable regions of the trunk and extremities. The patient cannot bear to be touched, however lightly; and still less can he endure to be moved. He is irritable or plaintive if these proceedings be attempted. Owing to the varying nature and extent of the spasms, and the

different degree of paiu endured, the position assumed by the patient is very various in different cases.

Difficulty in defæcation and in micturition often exists, especially in the early stages of the disease, and this is supposed to be due to a spasmodic condition of the sphincters. The respiration and the heart's action are principally interfered with in cases where the cervical meninges are gravely involved.

The temperature seems to pursue a somewhat irregular course, but concerning this further information is needed. It may be only slightly above the normal; and may not rise much beyond 102°, even in fatal cases, till uear the end. Then it may rise considerably in the course of a few hours; whilst in other cases it may at this same period become depressed below the normal.

In the later stages of the disease some amount of paresis, or actual paralysis, may be noted in one or more limbs; the pains on movement and the skin-hyperæsthesia become less, or may indeed be intermixed with tracts in which actual anæsthesia exists. The bladder may at last be paralysed; and respiration may be most gravely interfered with, so that disturbance of this function, as well as of the heart's action, may be the actual cause of death.

These symptoms are, in all probability, as Erb maintains, due in very great part to the inflammatory and other changes by which the anterior and posterior nerve-roots are implicated. Others may be due to extensions of the inflammatory process to the substance of the spinal cord, thus leaving a somewhat uncertain minority of symptoms to be accounted for by the mere implication of the pia mater itself.

The grouping of symptoms is apt to vary much in different cases, according as there is or is not the coexistence of a cerebral meningitis; or, in the absence of this complication, according as the inflammation is more or less localised in different regious of the cord, or general in its distribution. Much will depend also upon the severity of the process, and upon the extent to which the substance of the spinal cord becomes involved in the course of the disease.

Diagnosis.—Fever; pains in the back and limbs, greatly aggravated by movement; together with stiffness of the neck, trunk, or limbs; local muscular spasms; hyperæsthesia of the skin; retention of fæces and urine; dyspnœa; with a tendency in the later stages to the supervention of paresis, or actual paralysis of limbs—these are the symptoms, the combination of which to a marked extent becomes almost typical of spinal meningitis.

Its complication with a basal cerebral meningitis is, amongst other signs, chiefly indicated by the occurrence of vomiting, headache, slight delirium or stupor, paralysis of ocular muscles, difficulty in deglutition, loss of speech, or convulsions. The presence of many of such symptoms may, from their great importance, tend to dwarf or obscure those due to the inflammation of the spinal meninges alone; on the other hand, if they are absent we may feel assured that the inflammation has not also involved the base of the brain.

The fact that a meningitis is spiual in seat, and unaccompanied with cerebral symptoms, is of itself exceedingly good evidence to prove that it is not the tubercular form of the affection.

To settle the question, which membranes of the cord are inflamed in any given case, we must be guided much by what we can learn concerning the causal conditions and the distribution of the inflammation, rather than by any at present known differences in the grouping of symptoms. Thus inflammations of idiopathic origin, or those which are cerebro-spinal in seat, will almost invariably be found to be instances of leptomeningitis; whilst those set up as a result of caries of the vertebræ, or as a sequence of a sloughing sacral bedsore, are certainly much more prone to take the form of pachymeningitis, or of this in combination with arachnitis.

In reference to the diagnosis of spinal meningitis from other affections, it may be said that a very slight amount of attention to the nature of the pains and attendant conditions will suffice to avoid the mistake of supposing them to be rheumatic in nature. And, similarly, the absence of trismus in the early stages, and of any extremely well-marked exaltation of reflex excitability, together with the presence of severe pains in the back and limbs, will be negative and positive characters sufficient for distinguishing spinal meningitis from tetanus.

Another disease with which spinal meningitis is liable to be confounded is acute softening of the spinal cord. But the distinction should be easy in the early stages; and the history of the course of the affection will guide us later on, when symptoms of actual paralysis may have become developed. Still, in certain cases, a spinal meningitis may entail a softening of the cord to a marked extent, and then the symptoms of the primary affection will gradually be merged in those of the other which it induces.

A very rare condition, once met with by the present writer, is, he thinks, almost impossible to be diagnosed from spinal meningitis—that is, where a sarcomatous or carcinomatous new-growth springs up rapidly throughout the spinal pia mater iu the situation usually occupied by lymph or pus, especially when, as in the instance referred to, the disease seems to be the direct sequence of a fall from a height or over a flight of steps, aud death takes place

within a period of two or three months (see *Trans. Path. Soc.*, 1887, p. 31).

PROGNOSIS.—The prognosis of spinal meningitis depends a good deal upon the nature of the primary or causal conditions; upon the question whether the disease shows a tendency to extend to the cerebral meninges; upon the severity with which it implicates the cervical region of the cord; and also to some extent upon the age and general state of health of the person attacked.

Spinal meningitis is a disease which proves fatal in the course of a few weeks in a very large percentage of cases; complete recovery is certainly a rare exception; but late and partial recovery—that is, after the disease has lasted long, and with the remainder of some amount of muscular atrophy or incurable paralysis—is a little more frequent. In such cases the disease after a time lapses into a chronic condition, and the patient very gradually recovers, except, perhaps, for such incurable sequelæ as are above mentioned. But even in these cases tending towards recovery, a relapse is most easily brought about, owing to the recommencement of the disease in an acute form.

Where spinal meningitis supervenes upon a sloughing bed-sore existing in a case of paraplegia, the end is usually not far distant. The gravity of any case of spinal meningitis is also always greatly enhanced when the disease spreads to the cerebral meninges. And, so far as the spinal meninges themselves are concerned, any great intensity of the inflammatory process in the cervical region is always of the gravest import, because of the liability to secondary implication of the cord itself in these regions, either structurally or functionally, and the bringing about from this cause of serious interference with the functions of respiration and circulation. A continuously rising temperature in such a case—to 105° and onwards—is also of fatal import.

TREATMENT.—The severity of spinal meningitis is apt to prompt to the use of active measures of questionable utility; among these may be cited free local blood-letting, the free application of ice to the spine, and active purgation. It is difficult, too, to say on what principle it is thought absolutely necessary to apply cold when we have to do with an inflammation within the spinal canal or within the cranium, whilst we almost always apply heat externally in the case of an inflamed pleura, an inflamed peritoneum, or even an inflamed skin-tract. Probably the application of ice in such cases tends to alleviate pain, so that where this is great its use may bring much relief to present suffering, when hot applications would only aggravate it. But were it not for the fact that in meningeal inflammation (whether spinal or cerebral) increased fulness of vessels around sensitive organs shut in by unyielding walls almost necessarily leads to aggravation of pain, the application of heat would probably be more beneficial than that of cold, so far as the possible resolution of the inflammatory condition itself is concerned.

The patient should certainly be kept in a cool, quiet room, and lying either on his side, or, if possible, on his face on a comfortable bed. He should be well supplied with spoon diet of the most nourishing description, together with eggs and a moderate amount of stimulants, according to the indications presented by his symptoms and general condition.

Iodine liniment may be painted along each side of the spine in the affected region every second or third day. Pain should also be eased by opium or morphine; in fact, an opiate treatment may be resorted to in a large proportion of the cases. When opium and morphine do not agree, or are not admissible, Indian hemp would be worthy of trial as a mere anodyne; or we must fall back upon bromide of potassium and chloral hydrate, though the latter must be used with great caution where the heart's action is slow, irregular, and seriously interfered with. Belladonna and ergot have also been recommended, on somewhat doubtful grounds, as anti-inflammatory remedies in spinal meningitis.

We ought, in fact, to endeavour to combat the most urgent symptoms as much as possible, even if we cannot, by counter-irritants and by the judicious use of drugs, modify the course of the inflammation. Also by suitable feeding and judicious nursing we should endeavour to tide the patient through the disease. And if, happily, the activity of the inflammatory process subsides, the most unremitting attention will still be required to protect the patient against a relapse. Should his condition otherwise admit of it, the absorption of inflammatory products would, in this stage, be likely to be promoted by the use of a small dose of perchloride of mercury (such as one-sixteenth of a grain for an adult), in combination with increasing doses of iodide of potassium. At the same time, every effort must be made to restore the patient's general health, and to combat the emaciation which the disease itself usually involves.

H. CHARLTON BASTIAN.

MENINGES, SPINAL, Hæmorrhage into or upon.—SYNON.: *Hæmatorrachis*; Meningeal Apoplexy (Spinal).

Effusions of blood upon, between, or beneath the spinal meninges are altogether rare events, contrasting notably in this respect with the comparative frequency of parallel conditions on the side of the cerebral meninges.

ÆTIOLOGY.—Among the causes of meningeal hæmorrhages, stabs, blows, or falls will

hold a first rank. After these causes we should have to cite impediments to the circulation of blood, occasioned by various respiratory or muscular spasms, occurring either in the course of whooping-cough, or during some more than usually violent convulsive attack—epileptic, tetanic, or other. The lifting of heavy weights, or other great voluntary muscular exertions, may likewise at times prove causes of spinal meningeal hæmorrhage. Occasionally, however, it occurs independently of any such, or of other readily assignable causes.

Anatomical Characters.—Fluid blood or blood-clots may exist in relation with the spinal meninges in three different situations.

The most frequent site of such hæmorrhage is (1) outside the dura mater, between it and the vertebral arches. Here large clots are sometimes found, wholly or more frequently in part surrounding the dura mater in the region in which the hæmorrhage has occurred. Where the effusion is large, the cord itself may be distinctly compressed, but even smaller effusions may produce some amount of compression of nerve-roots. A clot in this situation, as in other sites, will, of course, become much modified in appearance with age.

Clots and more or less fluid blood may also, but more rarely, be met with (2) inside the dura mater, within the so-called arachnoid sac. This occurs perhaps most frequently as a mere sequence of a similar hæmorrhage taking place in the cerebral meninges, the blood simply gravitating into the spinal canal. Sometimes, however, especially in cases of spinal pachymeningitis, blood is actually effused in this situation—and that where the internal surface of the dura mater is much more vascular than natural. The opening of a thoracic or abdominal aneurysm may also very rarely take place into the spinal canal, and thus produce sudden and grave compression of the spinal cord.

Much smaller extravasations of blood are also met with (3) beneath the arachnoid and within the meshes of the pia mater, over areas perhaps small in extent longitudinally, but more or less embracing the cord in one or more regions. The cord or nerve-roots may, however, be decidedly compressed by such hæmorrhages, even when they are small in amount, owing to the space into which the effusion takes place being comparatively shallow.

Symptoms.—The symptoms of these affections are in a large proportion of cases vague and ill-defined. They may be much obscured by the causal conditions. In other cases they will vary in distinctness according to the amount and abruptness of the hæmorrhage.

As a rule, the onset of symptoms is sudden. Pain in the region of the spine, in which the hæmorrhage exists, or radiating thence along the nerves emanating from this region, may be the first symptom. More rarely, muscular twitchings or spasms may exist, either alone or with pains. These symptoms, dependent upon irritation and compression of sensory and motor nerve-roots, are at other times almost wholly absent. There may then be as abiding symptoms mere numbness or tingling in the parts affected, together with a sense of weight and paresis in the limbs. Actual paralysis is rare: and even when it is present, the rectum and bladder mostly escape.

Where pain exists, there is often stiffness of the spine; and these in combination greatly interfere with movement. Febrile reaction is usually absent or very slight. The severity of the symptoms may abate after a day or two, leaving only more or less paresis. In the case of large hæmorrhages, however, with extensive compression of the spinal cord, death may be rapid, occurring in the course of some hours or of a day or two.

The symptoms will vary as the effused blood presses upon the cord in the cervical, the dorsal, or the lumbar region. Where the effusion is in the cervical region in a traumatic case, in which there is obvious head-injury with a condition of stupor, it is almost certain not to be diagnosed. The patient is not sensible enough to complain of pain; and the irregular respiration and small disordered pulse, with slight tremor or rigidity of one or both upper extremities, may with more probability be ascribed to multiple head-lesions—as actually happened in a case which recently came under the writer's notice.

Diagnosis.—It may be impossible to diagnose hæmorrhage into the spinal meninges in cases where it occurs as a concomitant of other grave diseases—such as tetanus, eclampsia, or cerebral hæmorrhage; and also in cases where it merely complicates a traumatic injury of the spinal cord itself. In other cases, the presence of certain causal conditions, together with the abrupt commencement of spinal symptoms in such combinations as have been above referred to, is sufficient to enable us to diagnose it from hæmorrhage into the substance of the cord, as well as from meningitis, or acute softening (*see* Spinal Cord, Diseases of). The gradual onset of the symptoms arising from tumours of the spinal cord, or of the spinal meninges, makes it more easy to separate these affections from meningeal hæmorrhages.

Prognosis.—Spinal meningeal hæmorrhages are as a class decidedly less grave than meningeal tumours. They are unlike the latter, moreover, inasmuch as the worst symptoms attendant upon them are produced at once, instead of being only very slowly evolved; so that after a short time, unless the blood effused happen to have produced a certain amount of compression of the

spinal cord, the symptoms gradually diminish in severity. Large extra-meningeal hæmorrhages, compressing the cervical region of the cord, are by far the most serious forms of this affection.

TREATMENT.—In the treatment of spinal meningeal hæmorrhage the patient must, of course, be kept perfectly quiet and in the recumbent position. Spoon diet should be administered for a few days; and vascular sedatives, such as aconite, may be given with advantage. Some recommend active purgation, and the abstraction of blood from the neighbourhood of the spinal column by cupping or leeches. These measures, however, are of questionable utility, and the former especially might easily do positive harm.

In certain cases, especially in the extra-meningeal form of the disease, a surgical operation for the removal of the compressing blood-clot may be advisable.

H. CHARLTON BASTIAN.

MENINGES, SPINAL, New-Growths and Adventitious Products of.—This subject requires no very lengthy discussion. As has been said in regard to such growths and products springing from or connected with the cerebral meninges, the symptoms to which they give rise are in the main referable to irritation and pressure upon adjacent portions of the nerve-centres, or upon certain nerve-roots. The symptoms, therefore, of meningeal growths or adventitious products are almost, if not quite, indistinguishable from those produced by similar bodies in the spinal cord.

The sections on special symptoms and diagnosis which might otherwise have appeared here may be suppressed; and the reader be referred for their equivalents to what he will find under the head of SPINAL CORD, Special Diseases of.

We shall now merely give a few details concerning the ætiology, nature, and precise sites of the various new-growths and adventitious products that may be met with in connexion with the spinal meninges, and shall supplement these details with some few general remarks bearing upon the prognosis and treatment of such affections.

ÆTIOLOGY.—In accounting for certain tumours, such as those of a syphilitic, of a scrofulous, or of a cancerous type, we may fall back upon the existence of a general 'predisposition'; though what determines the appearance of such tumours in this or that particular situation generally remains as much a matter of uncertainty as when the growths are solitary or of non-diathetic origin. Among such determining or exciting causes only one of those usually cited seems to be of real potency, namely, the occurrence of blows or injuries of various kinds. These certainly appear at times to be—in the spinal meninges as in other situations—the immediately exciting causes of certain new-growths.

Parasites, such as cysticerci and hydatids, gain entry to the system in the way mentioned in the articles on these subjects; but something so indefinite or accidental as to be spoken of by us as 'chance' will determine their appearance in this or that particular tissue or organ.

A. **New-Growths.**—(*a*) *Cancer.*—Cancer occurs most frequently in the spinal meninges, not as a primary affection, but by extending to them from a previous cancerous growth in one of the adjacent vertebræ. The space within the spinal canal being very limited, such a tumour soon begins to press injuriously upon nerve-roots and upon the cord itself. In rare cases, however, a cancerous new-growth may start from the spinal dura mater.

(*b*) *Tubercular growths.*—These masses are met with principally in cases of tubercular disease of the spinal column, and especially where angular curvature is produced, though they are not confined to these more severe forms of vertebral caries. Caseating growths are in such cases apt to extend from the vertebræ, so as to infiltrate the dura mater, and then produce fungating excrescences on its inner surface. Small isolated scrofulous tumours, the so-called 'tubercular' growths, may also be met with, though more rarely than in the cerebrum, springing from the spinal pia mater, and more or less imbedding themselves in the substance of the spinal cord.

(*c*) *Syphilomata.*—Syphilitic growths are also decidedly less frequent in connexion with the spinal than with the cerebral meninges. Small tumours may, however, spring either from the dura mater or from the arachnoid and pia mater. Or, instead of well-defined tumours, there may be thickenings of the membranes in some part of their extent, and adhesions between one another and the surface of the cord, by means of opaque, yellowish-white, gummatous growths.

(*d*) *Sarcomata.*—Sarcomatous tumours of all kinds may be met with in connexion with the spinal meninges, springing occasionally from the dura mater, but more commonly from the arachnoid and pia mater. Instead of being distinctly circumscribed, such growths may exist in the form of diffuse infiltrations, invading the pia mater all round the cord for a variable extent. In one remarkable case the writer met with a growth of this kind involving the pia mater throughout the whole length of the spinal cord, which was most developed on its lateral and posterior aspects. Here in some places the layer of new-growth was about one-third of an inch in depth, and the cord was notably compressed in its postero-lateral aspects (*Trans. Path. Soc.*, 1887, p. 31).

(*e*) *Myxomata.*—Myxomata are met with in the form of small circumscribed tumours, springing mostly from the pia mater. The writer has seen one about the size of a very large almond situated on, and greatly compressing, the posterior columns of the cord. Its presence was associated with very obscure and ill-defined symptoms during life.

(*f*) *Tubercle.*—Tubercles in the form of 'grey granulations' have already been referred to. *See* MENINGES, SPINAL, Inflammation of, Simple Idiopathic and Tubercular.

(*g*) *Fibromata*, (*h*) *Lipomata*, and (*i*) *Enchondromata.*—These various kinds of new-growth have been met with occasionally, but principally in connexion with the outer aspect of the dura mater.

(*k*) *Osteomata.*—These formations are here of no clinical significance, though they are much more common in persons of all ages on the spinal than on the cerebral meninges. They are apt to occur in the form of small bony plates scattered over the surface of the arachnoid. Sometimes a limited 'ossification' of the dura mater is also met with.

B. **Adventitious Products.**—*Parasites.*—The same two kinds of parasites may be found in connexion with the spinal meninges as we have already had to refer to in connexion with those of the cerebrum—namely, the small and often numerous *cysticerci*, as well as the more solitary and larger *hydatids*. The latter may be found within the dura mater, but they have been met with much more frequently outside this membrane, often forming large tumours contiguous to the spinal canal. These are the only adventitious products of any importance which occur in, or in relation with, the spinal meninges.

PROGNOSIS.—As a class these affections are grave, tending to produce, with some exceptions, various irregular forms of paralysis, and ultimately death, though this latter may take place only after the expiration of two, three, or more years. The symptoms produced by tumours and parasites, as a rule, go on increasing in severity; and the gravity of the prognosis will depend much upon their rapidity of growth, as evidenced by the increase of signs of severe compression of the cord or of its nerve-roots, in connexion with the state of other organs. The supervention of obstinate bed-sores, and paralysis with inflammation of the bladder, may at last greatly hasten the fatal termination.

TREATMENT.—In the treatment of tumours or parasites within the spinal canal, our efforts must be in the main directed to restoring or improving the general health of the patient, and to combating the more urgent symptoms that may arise—such as pain, spasms, paralysis, sleeplessness, bed-sores, and cystitis. Where, however, we have to deal with growths of syphilitic origin, we can attack the disease itself by means of drugs. Under the influence of small doses of mercury and increasing doses of iodide of potassium, the patient's condition may often be marvellously improved, though the relief is perhaps not so striking as in cases where syphilis affects the cerebral meninges, because in this latter disease the symptoms are more varied in nature, and more dependent upon added functional complications.

In cases of hydatids and also of tumours in connexion with the spinal meninges, the question of the possible relief of the patient by means of a surgical operation should always be entertained. The chances of success in this direction are considerable in the case of hydatids; and in many cases also where circumscribed meningeal tumours exist there is a reasonable chance that a skilful operation may effect a cure, or, at all events, bring great relief for a time.

H. CHARLTON BASTIAN.

MENINGOCELE.—*See* BRAIN, Malformations of; and SKULL, Diseases and Deformities of.

MENINGO-CEREBRITIS.—A name given to a pathological condition in which inflammation of the pia mater extends in some regions of the cerebrum so as to implicate the subjacent cortical substance. The fact of such an extension is much less capable of being diagnosed during life than of being discovered after death, but it may then be recognised by the existence of superficial softening of the brain-substance, together with a more or less marked increase of vascularity. This condition probably always exists to a certain extent in meningitis, and might reveal itself on careful microscopical examination—although the inflammatory changes may not have advanced far enough to produce an easily appreciable amount of softening.

MENINGO-MYELITIS is a term used to indicate a condition in which inflammation of the spinal meninges has extended to the surface of the spinal cord. The evidence of such an extension has usually been supposed to depend upon the existence of an appreciable amount of superficial softening. But minor changes of an inflammatory type, capable of recognition by the microscope, may also here exist with frequency, as F. Schultze has shown, although they may fall short of entailing actual softening.

MENOPAUSE (μηνές, the menses; and παῦσις, a cessation).—The natural cessation of the menstrual flow, or 'change of life' in the female. *See* CHANGE OF LIFE.

MENORRHAGIA (μηνές, the menses; and ῥήγνυμι, I burst forth).—Over-abundant menstruation, whether due to excessive quantity or to undue frequency. *See* MENSES or MENSTRUATION, Disorders of.

MENSES or MENSTRUATION, Disorders of.—Synon.: Fr. *Troubles de la Menstruation*; Ger. *Störungen des Monatsflusses*; *Störungen der Menstruation.*

Menstruation is the periodic discharge of a sanguineous fluid from the female generative organs. The discharge continues each time for from three to eight days. It varies in quantity in different subjects. The estimation of this is surrounded by great difficulties; usually, however, the quantity is from four to six or eight ounces. It takes place monthly; that is, a period of twenty-eight days intervenes from the appearance of one flow to the appearance of the next following. In many cases, however, this interval is less than twenty-eight, and may be as short as twenty-one days; on the other hand, it may be prolonged to thirty-one days, and the function be still performed normally. The discharge does not appear during childhood or old age. It usually appears for the first time between the twelfth and fifteenth years, and for the last time between the forty-third and forty-eighth; but it may appear as early as the ninth, and continue to appear regularly afterwards up to the fifty-third or fifty-fifth year. The function is suspended during pregnancy, and, as a rule, during lactation. The source of the discharge is the body of the uterus. It is not due to a congestion or an erection of that organ, as has been supposed, but to the degeneration, disintegration, and removal of the so-called mucous membrane of the uterus—the decidua menstrualis. In consequence of this degeneration and disintegration, the vessels on the inner surface of the uterus are opened, and hæmorrhage follows. The ultimate cause of the discharge is said to be the separation of ova; such, however, is not the case in every instance, for menstruation may take place without the discharge of an ovum, and, on the other hand, ova may be separated from the ovary without the occurrence of menstruation. It can hardly be doubted, however, that the function is in some manner dependent on the ovaries, for when the latter have been removed menstruation ceases.

The fluid is not in all cases sanguineous: indeed its bloody character may be regarded as accidental, though present in the infinite majority of cases. It may, however, be easily understood that the disintegration and removal of the decidua menstrualis, which is the essential factor in menstruation, may be effected without the occurrence of hæmorrhage, and there is reason to believe that in so-called 'white menstruation' such is the case.

For the due performance of the function two conditions are essential, namely, sound general health, and normally developed organs of generation. Disorders of the menstrual process may be brought about by very many conditions. These disorders are generally divided into: I. *Amenorrhœa*, where the discharge is absent, or deficient in quantity. II. *Dysmenorrhœa*, where the function is performed with difficulty and pain. III. *Menorrhagia*, where the discharge is profuse.

I. **Amenorrhœa.**—Synon.: Fr. *Aménorrhée*; Ger. *Amenorrhoë.*

Ætiology and Symptoms.—Amenorrhœa is dependent either on *general* states; or on *local* pathological conditions—that is, on lesions of the uterus and ovaries.

(1) All conditions or influences which tend to deteriorate the blood, or which act unfavourably on nutrition, may be causes of amenorrhœa. The most common of these is the demand made on the system in the development of the aptitude for conception, the growth and separation of ova, and the performance of the menstrual function. At this time the breasts develop, the ovaries and uterus enlarge, the pelvis grows, and the whole form becomes altered. Many women who during childhood have enjoyed apparently perfect health, as they approach puberty become gradually or suddenly anæmic or chlorotic, without any assignable cause other than the demand made on nutrition by the process of development through which they at the time pass. Nutrition becomes impaired, tastes perverted, pains of a neuralgic character are felt in various parts of the body, the menstrual discharge does not appear, or it may appear once scantily and then at irregular intervals, or it may disappear for months or even years. All the symptoms of anæmia are present, and the patient is languid and listless, lacks energy, and is in more or less constant suffering. The above course of events may take place even in cases where the surroundings are favourable to healthy development. Hygienic conditions, however, play a most important part in the proper development of the female functions, and when the surroundings are unfavourable, evil is sure to follow. Want of food or improper food, want of fresh air or impure air, want of exercise, foul gases, malaria, are prolific causes of failure or imperfection in the growth and development of the young girl, and are common causes of amenorrhœa. Disease also is by no means an infrequent cause of the condition under consideration, such as phthisis, Bright's disease and diseases of the liver, stomach, and nervous system. Emotion, fright, or grief, change of air and food (as when girls go from the country to London), and cold, may arrest or suspend the monthly discharge.

(2) But amenorrhœa may be due to local conditions. These are absence or disease of the ovaries, of the uterus, or of both; and imperfect development of one or both organs.

In cases where the ovaries are absent, the change in form, from girl to woman, which

takes place at puberty, does not occur. The girl grows but does not develop. A masculine appearance supervenes, the breasts remain small, the pelvis narrow, the voice becomes manly and harsh, a beard may grow on the face, sexual passion is absent, and the health remains good.

When the uterus alone is wanting, there may be no indication of the condition in the state of the general health or development, and local examination is necessary in order to detect the circumstance. In these cases the vagina terminates in a *cul de sac*, and the uterus cannot be felt on examination. On introducing a finger into the rectum and a sound into the bladder, it is found that the two organs are in contact, and that there is no uterus between them. There are, however, as a rule, one or two small fibrous masses representing the uterus.

Certain diseases, as scrofulous abscess and atrophy, which involve the whole substance of the ovaries, and also atrophy of the womb, may cause amenorrhœa.

Amenorrhœa from retention.—In these cases the sanguineous discharge is separated, but does not appear externally, owing to atresia of the genital canal. The closure may occur at any point between the os uteri and the vaginal orifice. A membrane may close the os tincæ; the hymen may be imperforate; the vagina may be absent; or its walls may be adherent at any part of its course, or along the whole of it. The occlusion may be congenital, or may arise from inflammation during childhood or after severe labours. In these cases the menstrual molimina are periodically present, but the catamenia do not appear. The molimina increase in severity from month to month; the patient has pain in the back and a sense of weight in the pelvis, and becomes pale and sallow; the abdomen after a time begins to enlarge, and continues to increase at monthly intervals. On examination a tumour having the shape of the enlarged uterus may be felt rising from the pelvis. It is smooth, elastic, and dull on percussion. If the condition be not discovered, the distension of the uterus may go on to rupture, or its contents may pass along the Fallopian tubes into the abdomen, causing peritonitis and death.

Diagnosis.—Whenever a patient suffers from amenorrhœa, pregnancy should be thought of. If this state can be excluded, the general condition should be investigated. Anæmia and its causes should be sought for. The chest, heart, and urine should be examined. If there be no general condition to account for the amenorrhœa, the practitioner should see whether the breasts and pelvis are developed, and examine the vulva and vagina for obstruction, if there be any suspicion of such a condition. Finally, it may be necessary to examine the uterus and ovaries.

Treatment.—The treatment of the first form of amenorrhœa is the treatment of the general state. If there be want of constitutional vigour, change of air, exercise in the open air, mental occupation, but not severe, and nourishing diet should be advised. The stomach and bowels should be attended to; and gentle aperients and salines given if the tongue be foul; then vegetable tonics, iron, iodides, or other appropriate remedies. No efforts should be made to act especially upon the uterus, and this is particularly binding when the amenorrhœa is dependent on phthisis, Bright's disease, or such-like conditions.

The second form is often incurable. In those cases in which the uterus and ovaries are absent nothing can be done. If the uterus be present, but imperfectly developed, much may be done when the cases are seen early, but nothing if seen late. Attempts have been made to promote the growth and development of the uterus by local treatment, but without success. For this purpose stem pessaries, galvanic pessaries, and irritants have been used, but with only injurious results. In these cases, whether they be seen early or late, local treatment is of no use, while general treatment, directed to improve the health and favour growth, may prove of the greatest value. Plenty of good plain food, walking exercise short of fatigue, and freedom from school and hard mental work, are the means which favour the easy and early transition from girlhood to womanhood; whilst over-work, sedentary habits, deficient or bad food, and bad air produce a rich harvest of physical suffering peculiar to women.

In cases of retention of the menses from atresia of the genital canal, an outlet must be made for the flow. If the hymen be imperforate it should be divided, and the fluid allowed to run out. In cases of absence of the vagina, a canal has in some instances been successfully made. This, however, should only be done in cases in which the uterus and the ovaries are developed. In atresia of the os uteri the offending structure should be divided by the trocar or knife. These operations are accompanied by a considerable amount of danger. Patients not infrequently die after them from peritonitis or shock. It should not be forgotten, however, that it is imperative to remove the menstrual fluid retained, for unless this be accomplished death is inevitable.

II. **Dysmenorrhœa.**—Synon.: Fr. *Dysménorrhée*; Ger. *Dysmenorrhoë.*

In dysmenorrhœa, menstruation is accompanied by pain—that is, pain referable to the genital organs. This pain is seated in the pelvis, and radiates to the sacrum, groins, and thighs. In some women the menstrual function is performed without pain or discomfort of any kind. As a rule, however,

they suffer more or less from dull aching in the pelvis, backache, headache, languor, and lassitude during the catamenial flow. When the dull aching amounts to sharp pain, the function is performed abnormally, and the woman is said to suffer from dysmenorrhœa. This symptom is frequently met with, and in association with many pathological conditions of the pelvis; diseases of the uterus, such as fibroids; of the tubes, such as congestion and inflammation; of the ovaries; and also with general diseases, such as anæmia, gout, and rheumatism.

Ætiology and Symptoms.—Dysmenorrhœa has been referred to five different conditions, upon one or more of which it is supposed to depend. Hence five kinds of dysmenorrhœa have been described: (1) *Mechanical or obstructive*; (2) *Congestive or inflammatory*; (3) *Ovarian*; (4) *Membranous*; and (5) *Spasmodic or neuralgic*.

1. *Mechanical or obstructive dysmenorrhœa.*—This form of dysmenorrhœa was long thought to be the most common; indeed, it has been asserted that dysmenorrhœa cannot be said to exist without obstruction to the flow of blood from the uterus. Opinions, however, differ greatly with regard to the seat of the obstruction. Dr. Robert Barnes believed it to be seated usually at the os tincæ, and to be frequently accompanied by conical cervix; Dr. Marion Sims thought its most frequent seat was the os internum uteri; while Dr. Graily Hewitt referred the obstruction to flexion of the uterus in the great majority of cases—the obstruction being caused by the narrowing of the uterine canal at the point of flexion. The outer orifice of the uterus may be closed from birth, or in consequence of inflammation occurring subsequently, and thus cause obstruction to the escape of the catamenial fluid. There is no question therefore that this condition is one that may give rise in some way to painful menstruation. Such a narrowing of the os externum as to give rise to dysmenorrhœa is, however, extremely rare. A narrow, or so-called pin-hole os generally admits the uterine sound, and women, subjects of this condition, frequently menstruate without pain. Indeed, it has been abundantly proved that pin-hole os plays no part in the production of dysmenorrhœa. The same may be said of contraction of the inner orifice. This part is rarely or never met with so small as to prevent the passage of the sound, and just as rarely presents obstruction to the escape of the fluid. Wherever the sound can be passed it may be safely inferred that there can be no obstructive dysmenorrhœa. That flexions of the uterus can interfere with the calibre of the canal and obstruct the menstrual flow is a simple theory, and all observations in the dead body go to show that it is fallacious, for the few flexed uteri which are found in our museums present patent canals. The only instances in which the canal is constricted by flexion are those in which senile atrophy has taken place—that is, when the walls of the organ have become thinned by age; but by this time the menopause has been passed, and dysmenorrhœa become impossible. So called retroflexion of the uterus may, however, give rise to dysmenorrhœa when the body of the organ sinks into the pouch of Douglas, and it, together with the broad ligaments, becomes constricted by the sacro-uterine ligaments. Just as hernia of the uterus may give rise to congestion and dysmenorrhœa, so such a condition would prevent the return of the blood along the uterine veins, and lead to swelling and congestion of the body of the uterus, and painful menstruation.

2. *Congestive or inflammatory dysmenorrhœa.*—This name has been given to those cases of painful menstruation in which the uterus is enlarged and heavier than natural. It is met with in the married and in the single, but it is probable that it never occurs as a primary affection. Congestion and inflammation are frequent accompaniments of dysmenorrhœa when they are not the cause of it. They are generally the result of labour or abortion, or of dysmenorrhœa itself, of infection or mischievous meddling, more especially the use of instruments, such as the uterine sound. The symptoms are a continuous dull aching pain, chiefly in the sacrum and thighs, and a sense of weight and fulness in the pelvis. This form does not deserve the name of dysmenorrhœa, for the pain is at its worst at other times than during menstruation, and is frequently relieved by the appearance of the menstrual flow.

3. *Ovarian dysmenorrhœa.*—This does not deserve the name of dysmenorrhœa, for it is not due to menstruation—that is, to the discharge of the sanguineous fluid from the uterus, but to the growth and rupture of the Graafian follicles. The Graafian follicles develop gradually, and take a long time to arrive at maturity. It is not a sudden process. Towards the end of their growth, when they are about to rupture, the ovarian pain is experienced. They usually burst some time before the appearance of the menstrual flow, but the rupture may happen during the flow or after its cessation. Pain usually comes on before the flow—a few days or a week—and may cease with the appearance of the menses, or several days before that event; the suffering may, however, come on at any time during the flow or immediately after it has ceased, or at any time during the interval. It is situated usually in the left ovarian region, for the left ovary is more frequently affected than the right, the pain extending down to the thighs and to the sacro-iliac joint of the same side. Not infrequently the corresponding kidney is tender. Pain may

occur in the right or left side at alternate periods—or a period may pass without pain. Vomiting and hysterical manifestations are often present. There is superficial and deep tenderness over the painful part. Patients often say that they have a swelling in the side, and, on examination, a diffused fulness is found in the ovarian region, which is tympanitic, and evidently due to local distension of intestine with gas. Examination per vaginam and per rectum will often detect a small body or swelling, tender and movable at first —later on fixed—on the affected side and a little behind the uterus. Pressure on the swelling calls forth severe pain and a feeling of sickness. At a later period the uterus becomes less movable and drawn to the affected side. This is, doubtless, due to contraction of inflammatory products, and not to distension of the broad ligaments, for it occurs in long-standing cases only. Micturition is frequent and painful. The pathological lesion is inflammation of the uterine appendages— the tubes, the ovaries, and the peritoneum, the Graafian follicles, the stroma, or the surface of the ovaries, one or all may be affected. This condition is again rarely primary. In women who have had children it is often due to parturition and abortion. In the unmarried, it is often the result of long-standing dysmenorrhœa—sometimes of acute specific disease, or of inflammatory mischief set up by causes mentioned in the preceding paragraph, or exposure to cold during menstruation.

4. *Membranous dysmenorrhœa.*—In this form a membranous sac, having the shape of the body of the uterus, is expelled with the menses. The sac has three orifices corresponding to the orifices of the Fallopian tubes and the inner orifice of the uterus. It has an internal smooth, punctated, and an external flocculent surface. Occasionally during expulsion the sac is turned inside out. It may be passed with every or every other menstruation, or only occasionally. Instead of being passed in the form of a complete sac, the membrane may be broken up and expelled as shreds of various sizes. Microscopic examination shows that the membrane possesses a structure identical with the lining of the body of the uterus. It contains glands and blood-vessels, and is, in fact, the decidua menstrualis. It has been said that this membrane is always the result of conception, but ample evidence has been published in refutation of this statement. Other bodies may be expelled from the uterus during menstruation, such as clots of blood, fibrin, masses of mucus forming casts of the uterine canal, casts of the vagina, and products of conception. Several cases of monthly abortion have been recorded. These substances can be distinguished from the decidua menstrualis by microscopic examination only, and easily, except the products of conception. These present the structure of the decidua; but they also present some additional appearances which, if found, are characteristic, such as the sac— partial or complete—formed by the decidua reflexa and the large cells which are met with in the decidua vera and chorionic villi. When cases of this disorder come under notice the uterus is, as a rule, enlarged. This, however, is not always the case. The enlargement is probably a condition secondary to the dysmenorrhœa or to previous gestation. There is commonly tenderness of the pelvic tissues around the uterus, probably of the peritoneum. Ovaritis is frequently present. These conditions are probably secondary. Affections of other mucous membranes may be present, such as bronchial catarrh. Membranes may be passed from the uterus without pain; or pain may be present, but varying in degree from slight discomfort to intense suffering. The severest pains, however, are not due to obstruction caused by the passage of the membranes blocking the os uteri and causing retention of the fluid, but to spasm of the uterus. The passage of the membrane takes place often on the third day of menstruation, but it may occur later. Frequently shreds are passed from the first or second day to the end of the flow. With the expulsion of the membrane there is usually a gush of blood, after which the flow proceeds normally. The catamenial discharge may be normal in amount, considerably increased, or even scanty.

The pathology of this affection is somewhat obscure. Several views have been held with regard to it, some of which deserve no notice. Inflammation, however, is so frequent an accompaniment, that the view that inflammation is its cause is one which deserves attention. Against this view is the fact that about two-thirds or three-fourths of the cases are cases of primary dysmenorrhœa, in which inflammation could not have been present; and it is consequently inferred that the inflammation, which is so often present, is really a secondary development, being the result of the dysmenorrhœa; moreover, on no other surface of the body is inflammation known to give rise to a periodical exudation of this kind, or to change the character of the mucous surface in such a manner as to cause it to be shed in the way the mucous membrane of the uterus is shed in this disease. More recently it has been stated that the disease is the result of amyloid degeneration of the lining of the uterus. If such degeneration be present in some cases, it is certainly not in all. The cause is probably to be sought in malnutrition of the uterus, which in some cases has existed *ab initio*, while in others it has succeeded to some disease, such as inflammation or imperfect involution of the uterus after

pregnancy. It has been met with also in gouty and rheumatic subjects, but it is not known if it holds any relation to these diseases. The pathology of the affection appears to be a failure of the molecular disintegration of the decidua menstrualis which takes place during normal menstruation, and this must be due to the presence in the decidua of some tissue which resists disintegration more than the healthy tissues of that membrane. The only tissue which has been found in the uterine wall which would offer such resistance to disintegration is fibrous tissue. It is known that this varies somewhat in quantity in the wall of the uterus, according as it is diseased or healthy. In cases of inflammation of the uterus in which imperfect resolution has taken place, excess of fibrous tissue is found in the wall. In cases of sub-involution a similar excess is found, and it would be expected that in cases of imperfect development at puberty a similar excess would be found. It is known that the organs in which membranous dysmenorrhœa is met with are imperfectly developed uteri, uteri that have been inflamed, and uteri that have been pregnant and in which parturition or abortion has been followed by an imperfect return of the organ to its natural state; and it is maintained that the presence of an excess of fibrous tissue in the wall of such uteri is the cause of the shedding of the decidua as a membrane. This is the most probable explanation of the occurrence of membranous dysmenorrhœa.

5. *Spasmodic or neuralgic dysmenorrhœa.*—This form of dysmenorrhœa includes the very great majority of severe cases. For a time spasm and neuralgia were regarded as an asylum for ignorance, and other conditions which formed the basis of the mechanical theory of ·terine pathology were put forward in their place. Further research, however, has shown that spasm and neuralgia are by no means conditions of no importance in dysmenorrhœa, that the foundations of the mechanical system were laid in error, and that dysmenorrhœa is but another name for uterine colic. It is well known that with dysmenorrhœa, flexions of the uterus, a narrow external orifice, or a narrow internal orifice may be present, and it is equally well established that these conditions may be removed and yet the dysmenorrhœa remain. The inner and outer orifices may be incised, and the flexion straightened, without relief. The observations of Vedeler and Herman prove that the percentage of virgins who suffer from dysmenorrhœa is almost the same whether the uterus be straight or in a state of flexion. In fact, dysmenorrhœa is just as frequent in the absence of flexion of the uterus as when flexion is present; and every practitioner who has seen a considerable number of cases of dysmenorrhœa has ample proof that a narrow external or internal os is not a common cause of it.

Dysmenorrhœa may be divided into two categories—the primary and the acquired. Primary dysmenorrhœa is present from the commencement of menstruation, or soon afterwards. Acquired dysmenorrhœa comes on at a later period of life, after menstruation has been thoroughly established, often after pregnancy, labour, abortion, and in consequence of chills, inflammatory attacks of the pelvic organs, acute diseases, anæmia, and exhaustion. The primary variety forms the majority of cases, and in these no recognisable disease of the uterus is present. It is generally believed that the uterus undergoes regular contractions during menstruation. These cannot be observed in the healthy organ, but they have been witnessed in cases in which the uterus was enlarged by fibroid tumours. In health these contractions are painless. When they become irregular they are painful, and give rise to dysmenorrhœa. The pain is situated in the pelvis, and is referred to the uterus. It is of varying intensity; it may be slight; or it may be extremely severe—agonising. It radiates to the groins, sacrum, and thighs. It is often said to be all round the pelvis or lower part of the trunk, and is often compared to the pain of labour, or that of abortion. The pain may come on a little before, with, or a little after the appearance of the discharge. Usually it occurs during the first twelve or twenty-four hours, and lasts from four or five hours to twenty-four, or even to the end of the flow. It is paroxysmal. There is often tenderness of the skin of the hypogastrium and groins, vomiting, hiccough, headache, hysteria; and even delirium may be present. The menstrual flow may be scanty or profuse. In the former case it is often followed by an abundant yellow discharge lasting for a few days. There may be leucorrhœa throughout the inter-menstrual interval. Micturition is sometimes frequent and painful. Patients who suffer in this way may enjoy good health during the inter-menstrual interval, but often they suffer from neuralgic pains at other times than at the periods, and they frequently suffer from severe headaches at the time of their period.

Treatment.—Dysmenorrhœa is generally obstinate under treatment, and its course is very protracted. In many cases much may be done by attention to the general health, to the state of the stomach, liver, and bowels. During an attack, if severe, rest in bed should be enjoined and hot baths. As drugs, solution of acetate of ammonium, castor, phenazone, and phenacetin are useful; sometimes opium and morphine are called for, for the relief of the pain. Alcohol in small doses is useless, and in large quantities intoxicates. During the interval saline aperients, iron, arsenic, bismuth, iodide of potassium, and

ergot are of service; guaiacum resin alone or in combination with sulphur is sometimes of use. If there be a gouty or rheumatic tendency, this should be treated. As a rule, in these cases there is nothing to be gained by local treatment of so-called misplacement and conical cervix. Occasionally, however, in cases of severe retroversion or retroflexion, where the fundus of the uterus is grasped in Douglas's pouch, a pessary may be of use. Incision of the external orifice, in so far as the writer knows, is of no use. Relief sometimes follows incision of the internal orifice. Whether this relief is due to the enlargement of the canal caused by the incision, or to the stretching of the neck of the womb, which is generally carried out along with it, either by the introduction of a plug of lint or of a stem pessary, is still a debated question. The idea of incising the neck of the womb, whether at the external or internal orifice, is based upon an error in pathology, namely, that the pain is due to mechanical obstruction to the flow of the menstrual discharge from the uterus; and, as it is a dangerous, and may be even a fatal proceeding, it should not be undertaken. Dilatation of the cervix, however, is the most efficient means we have for the relief of severe dysmenorrhœa when drugs and other treatment fail. The object of this procedure is not to enlarge the canal for the passage of the menstrual fluid, but to stretch the neck of the womb in order to destroy the tendency to spasm. Indeed, it is done on precisely the same principle as dilatation of the vaginal orifice is done for vaginismus, and of the sphincter ani in cases of spasm of that muscle. The dilatation may be effected by the use of tents made of laminaria digitata or tupelo wood, or sponge; the former are preferable to the latter. They should be allowed to remain in the cervix for from six to ten hours, until the canal has been well dilated. Or, preferably, the dilatation may be carried out by means of bougies; metallic bougies are the best, graduated according to English measurement. The dilatation may be carried out at one sitting, when the patient is put under chloroform, and a series of bougies from No. 6 or 8 to No. 16 to 18 passed; or at several sittings, when one or two bougies should be passed every second or third day, until the required size has been reached. Hegar's bougies are often used for this purpose, but the English metallic bougies are in every respect preferable. Dilators have been used for this purpose also, such as Priestley's or Ellinger's. Some of these have three blades and some have two. Some are opened by a screw and some by hand pressure. There are many instances in which these instruments have lacerated the cervix severely, and, their use being accompanied by greater risk than that of bougies, they should be avoided.

III. Menorrhagia and **Metrorrhagia.** SYNON.: Vulg. Flooding; Fr. *Ménorrhagie*; *Métrorrhagie*; Ger. *Mutterblutfluss.*

Menorrhagia is used to denote profuse menstruation; metrorrhagia, hæmorrhage from the uterus at any other time than the catamenial epoch. The two symptoms are frequently met with. Menorrhagia often exists alone. When metrorrhagia is present during menstrual life, the catamenia are, as a rule, also profuse. These hæmorrhages may be called forth by many lesions. Indeed, they may accompany the majority of the pathological conditions to which the pelvic organs are liable. They may also arise from general states—as scurvy, the hæmorrhagic diathesis, Bright's disease, phthisis, cirrhosis of the liver, and the acute specific diseases. The most common cases are, however, associated with distinct alterations of structure in the pelvic organs, as sub-involution of the uterus, polypus, fibroid tumour, cancer, displacements, retained portions of placenta, moles (fleshy or vesicular), fungous degeneration of the mucous membrane of the uterus, mucous polypi, ulcerations of the cervix, hæmatocele, inversion of the uterus, and congestion of this organ due to obstruction to the circulation through the heart and lungs or liver.

Profuse hæmorrhages of an irregular character occur also in young girls before the advent of regular menstruation. This form of uterine hæmorrhage is not common, but it is sometimes of very serious import, and occasionally has proved fatal. More frequent is the occurrence of irregular bleeding from the uterus at the menopause. The causes of these climacteric hæmorrhages are really not known. They have been said to be due to congestion, but on insufficient evidence.

TREATMENT.—The treatment of hæmorrhage from the uterus resolves itself into the immediate treatment of the attack, and the treatment of the condition leading to it. The treatment of the attack, or the means of arresting the bleeding, consists in great part in securing absolute rest. The patient should remain in bed in the recumbent position, and avoid all exertion—mental and physical. At the same time, internal remedies which tend to check hæmorrhage should be given. Of these, those most commonly used are ergot, gallic acid, the mineral acids, and acetate of lead. Mineral acids, in combination with sulphate of magnesium or sodium, often act well. Should acetate of lead be administered, the patient should be carefully watched, as some persons are very sensitive to the action of the drug, and manifest symptoms of acute lead-poisoning after the administration of a small quantity. Should these means fail, recourse should be had to plugging the vagina or uterus. The vagina is plugged in the following manner: The patient is placed on

her left side, a speculum is introduced, and the canal is firmly packed with pledgets of iodoform or sal alembroth wool or gauze, tied on a string for convenience of removal. This will arrest the hæmorrhage for a time, but it can only prove a temporary expedient. The plug is liable to become offensive, from decomposition of blood and of the secretions in the vagina, and should consequently be changed in forty-eight to sixty hours, or sooner. A more efficient means of arresting hæmorrhage is plugging the uterus itself. This is done by means of tents of sponge or laminaria, and with a twofold object. The first object is the immediate arrest of the bleeding; but the chief object usually is to dilate the canal of the uterus, so as to permit its exploration by the finger, and the discovery of the cause of the bleeding. This means will not only check the bleeding temporarily, but will in many cases effect a permanent cure. Tents should be rendered aseptic by immersion for some days in a spirituous solution of corrosive sublimate (1 in 1,000). To facilitate the introduction of a tent, a Sims's speculum should be used, and the cervix of the uterus should be fixed by a sharp hook. In many cases, however, tents will not be necessary. The hæmorrhage will be controlled by the other means enumerated, or the cause of the hæmorrhage will be made out without the use of tents. In all cases, however, in which the hæmorrhage is uncontrollable, or so profuse as to threaten life, or in which the cause of the bleeding is obscure, tents should be had recourse to, both to check the flow and complete the diagnosis. When the cause has been discovered, it should, if possible, be removed.

But even after the uterine canal has been dilated, no definite cause may be found for the bleeding. In these cases, styptics, or even caustics, may be applied to the inner surface of the organ. Those chiefly used are a solution of iodine, a solution of perchloride of iron, chromic acid, and carbolic acid. These are best applied through a uterine speculum of platinum or vulcanite, on a probe of similar material. While using these means, it should be borne in mind that internal uterine medication is not free from grave danger.

The rest of the treatment of menorrhagia consists in attention to the general state.

JOHN WILLIAMS.

MENSURATION (*mensura*, a measure).—A synonym for measurement. *See* PHYSICAL EXAMINATION.

MENTAGRA (*mentum*, the chin; and ἄγρα, an attack: formed after *podagra*).—A name for affections of the chin. Its application is more general than that of *sycosis*. *See* SYCOSIS.

MENTAL DISORDERS.—*See* INSANITY.

MENTONE, France, on the extreme East of the French Riviera.—A moderately warm, bracing, sheltered, and dry winter climate. Mean temperature in winter 52° F.; rainfall 24 inches. *See* CLIMATE, Treatment of Disease by.

MERCURY, Diseases arising from. SYNON.: Fr. *Hydrargyrie*; *Intoxication Mercurielle*; Ger. *Quecksilbervergiftung*.

Though considerable discrepancies of opinion have existed as to the poisonous or innocent properties of the metal mercury itself when swallowed, there can be no doubt as to the poisonous character of its soluble and volatile compounds, nor even as to the insidious nature of the vapours of metallic mercury. Metallic mercury has occasionally been administered in enormous quantities without producing any decided physiological effects; whilst, in other instances, salivation and other specific effects have resulted. These differences are doubtless due to the fact that, in those cases where effects have resulted from the administration, oxidation and solution of a portion of the metal had taken place.

Mercurial poisoning may be either (A) *acute*, or (B) *chronic*; the former resulting from the administration of one or several large doses at short intervals, the latter form of mercurialism arising from the repeated exhibition of small doses of the less active preparations of the metal. There is also a peculiar form of mercurialism which is the effect of the inhalation of the vapours either of the metal or of its volatile compounds, and is characterised by paralysis.

A. **Acute mercurial poisoning.**—DESCRIPTION.—The effects produced by a considerable dose, say 60 grains, of one of the more soluble compounds of mercury, such as corrosive sublimate or the nitrate, are those of a corrosive and irritant poison. The effects are immediate. In the act of swallowing, an intense burning sensation is experienced in the mouth and throat, followed by excruciating pain in the stomach, and extending over the abdomen. The local effects of the poison are frequently visible, as a whitening of the tongue and fauces. There is vomiting, tenesmus, and purging, often of a bloody character. Colic, and great tenderness and swelling of the abdomen, are also symptomatic. Not infrequently there is suppression of the urine. The gustatory sensation is perverted; there is dryness of the mouth; and a brassy or metallic taste is generally experienced after the first local corrosive action of the poison has somewhat abated. The countenance is anxious; the skin is pale, cold, and clammy; and the pulse is small, weak, and rapid. Salivation may supervene, accompanied by fœtor of the breath. Should recovery not take place, death may occur within a few hours, or may be delayed for

one or more days; or the patient may more rarely succumb to some of the ordinary sequelæ of corrosive poisoning. When death supervenes speedily after the administration of the poison, the fatal result is usually due to collapse.

Most of the effects of acute mercurial poisoning may result from the application of a concentrated solution of corrosive sublimate to the unbroken skin.

Anatomical Characters.—The *post-mortem* appearances seen after acute mercurial poisoning are inflammation and even erosion of the mucous membrane of the stomach, and extravasation of blood beneath this membrane. Ulceration is rare. The intestinal tract also exhibits signs of extensive inflammation, and this has been noticed especially in the large intestine. The rectum is usually much inflamed, and its surface covered with shreds of bloody mucus. A peculiar slaty appearance of the mucous membrane of the stomach and intestines, where not highly inflamed, has been thought to be characteristic of poisoning by corrosive sublimate.

Diagnosis.—Though the symptoms of poisoning by corrosive sublimate, and other corrosive preparations of mercury, greatly resemble those produced by arsenic, the diagnosis is generally not difficult. The effects following almost immediately on administration, the metallic taste in the mouth, and the greater frequency of bloody stools in mercurial poisoning, serve to differentiate between the poisons. Where doubt exists, an analysis of the secretions may be made; arsenic is most readily detected in the urine, and mercury in the saliva. The existence of salivation and fœtor of the breath—though not always present—may also be valuable aids in completing the diagnosis.

Treatment.—In acute poisoning by corrosive sublimate, the best antidote is albumen, or the albuminoids in any soluble form. The white of one or more eggs should be beaten up with water, and swallowed as quickly as possible. Failing an egg, flour made into a thin paste may be administered. Albumen combines directly with corrosive sublimate to form an insoluble compound. On account of the powerful local action of the poison on the stomach, the use of the stomach-pump is not advisable; but if the vomiting be not free, emetics of as simple character as possible may be administered. The rest of the treatment consists in alleviating pain by means of opiates, and the general treatment applicable for irritant poisons. Thirst must be alleviated by demulcent drinks. For this purpose milk, mixed with once or twice its bulk of lime-water, is excellent; the casein of the milk and the lime both tending to render the mercury insoluble, and so to act as antidotes.

B. Chronic mercurial poisoning. Synon.: Mercurialism.

Description.—The repeated ingestion of small doses of the more soluble and active preparations of mercury, such as the perchloride and the bicyanide, may give rise to chronic symptoms; but these more frequently result from the administration of one or more doses of the more insoluble preparations of the metal, such as calomel or the oxides. When chronic symptoms follow the administration of one dose of a mercurial preparation, this is not altogether due to the peculiar idiosyncrasy of the patient, but is attributable in no small degree to the slowness with which mercury is eliminated from the system. There appears also to be a remarkable difference, not altogether dependent upon their differing solubilities, between *mercuric* or per-salts, and *mercurous* or proto-salts, in respect to their toxic properties. Mercuric compounds are greatly more potent than mercurous salts. By far the most common result of the continued administration of mercury compounds is salivation. This consists in a profuse discharge from the salivary glands; swelling and tenderness of the gums; and fœtor of the breath. In children, and more rarely in adults, salivation may pass into sloughing and gangrene of the cheeks; and a fatal result may ensue. Other symptoms are nausea, colicky pains, depression, and those nervous symptoms to which the term 'mercurial palsy' has been applied; but this last group of symptoms, which is most commonly met with after inhalation of the vapours of mercury, must be described more in detail.

Mercurial Paralysis.—Workers in mercury, such as water-gilders, looking-glass makers, and the makers of barometers and thermometers, are apt to suffer from a peculiar form of shaking palsy, known either as 'the trembles,' mercurial tremors or metallic tremors, and as *tremblement métallique* by the French. This disease affects those who handle the oxides of the metal, but more frequently those who are exposed to mercurial fumes. Mercury exhibits a small vapour-tension, and consequently is vaporisable at all ordinary temperatures, but the tension of its vapour below 60° F. is very small. The metallic tremors may come on suddenly or gradually, and they may be unaccompanied with salivation. The upper limbs are first affected, and then by degrees the whole muscular system. The patient is affected with tremors when an endeavour is made to exercise the muscles, so that he is unable to guide, for instance, a glass of water steadily to the lips; he cannot put his feet steadily to the ground; and when he tries to walk he breaks into a dancing trot. The muscles of mastication and deglutition are affected in advanced cases. Delirium and mania have occasionally followed the continued inhalation of mercury fumes.

Diagnosis.—The diagnosis of mercurial

tremors is usually not difficult. It must be admitted, however, that in some cases the tremors produced by mercury are in no way distinguishable from those due to the now well-recognised disease known as disseminated, multiple, or insular sclerosis. The former are less readily confounded with ordinary shaking palsy (paralysis agitans) and the convulsive movements of chorea. The history of exposure to mercury will seldom be absent. In paralysis agitans the tremors occur when the patient is at rest; and the peculiar forward gait, as if the patient were endeavouring to pass from a walking to a running pace, is characteristic. The metallic tremors come on only when the muscles are exerted, and usually they entirely cease when the patient is lying at rest or is asleep. The same may be said of the tremors of disseminated sclerosis; but here we have the peculiar consensual rotation of the eyes known as nystagmus. In paralysis agitans, when told to raise the affected hand, or to protrude the tongue, the patient performs both actions steadily. In mercurial tremors, and in disseminated sclerosis, the case is different—the tongue when voluntarily protruded is tremulous, and the patient cannot raise his hand when requested to do so, without shaking. In both mercurial tremors and the tremors of insular sclerosis, the muscular agitation ceases for the most part during sleep. In one form of metallic tremors the movements approach in character the convulsive movements of chorea.

Treatment.—In chronic mercurial poisoning, it is obvious that the patient must at once be removed from the further influence of the metal. Masks worn over the mouth are not of much use. In mercurial tremors cessation from working with the metal, and mild tonics of iron, usually suffice for the speedy restoration to health; but the shaking occasionally persists throughout life. For salivation and the more formidable gangrene of the mouth, besides cessation of the administration of the metal, and the exhibition of tonics, iodide of potassium may be given. Astringent gargles and active local treatment may perhaps be necessary.

Thomas Stevenson.

MESENTERIC GLANDS, Diseases of.—Of the lacteal glands, which lie in the folds of the peritoneum connected with the intestines, the mesenteric—corresponding to the small intestines—may be ranked as the most important; and what is described with regard to these will apply to the rest of the group. They are all really of the same nature as the lymphatic glands, and are subject to similar diseases. The statements made, therefore, with reference to these structures, will also apply in the main to the lacteal glands (*see* Lymphatic System, Diseases of); but the latter are likewise liable to certain special lesions, whilst their morbid changes present some peculiarities as regards their effects and symptoms. Thus, when the lacteal glands are diseased, the general nutrition tends to be markedly impaired, owing to the interference with the transmission and due elaboration of the chyle, and if they are extensively involved the entire system suffers gravely. Owing to their situation and anatomical relations, these glands, in certain forms of disease, may originate secondary effects of considerable importance. For instance, peritonitis may be excited by their irritation or rupture; or by their pressure on vessels or other structures, ascites and other conditions more or less serious may result. Enlarged mesenteric glands may in certain cases be felt through the abdominal walls. With these preliminary remarks, the particular diseases of the mesenteric glands will now be considered, so far as they may require special comment.

1. Acute Congestion and Inflammation.—The lacteal glands are very liable to become more or less congested or inflamed in connexion with any inflammatory condition affecting the intestinal canal. The situation and number of glands implicated will correspond mainly with the portion of bowel involved. They become enlarged, but the changes are seldom such as to give rise to any evident symptoms, and they subside as the cause of the irritation ceases to operate. In rare instances the inflammatory process may go on to suppuration, and then there is great danger of serious consequences; in one case which came under the writer's notice, fatal peritonitis appeared to have been set up by the irritation of a suppurating mesenteric gland.

In this connexion allusion may be made to the special implication of the lacteal glands in typhoid fever and dysentery. The nature of the changes which they exhibit is described in the articles on these diseases, and the glands affected correspond to the portions of intestine involved. They do not always return subsequently to their normal condition, but may remain permanently atrophied or otherwise changed. In exceptional instances the glands in typhoid fever have suppurated or sloughed in their interior; and they have even ruptured into the peritoneum, thus causing fatal peritonitis. *See* Dysentery; and Typhoid Fever.

2. Scrofulous or Tubercular Disease Tabes mesenterica.—The nature of this affection has been already discussed in relation to the absorbent glands generally (*see* Lymphatic System, Diseases of), and it will suffice to indicate here the special points which require to be noticed in connexion with the lacteal glands. Scrofulous or tuberculous disease of the mesenteric glands constitutes a most important disease in children and young persons, and its occurrence has

been attributed specially to the consumption of milk obtained from cows suffering from tubercle. It may exist independently, but is usually associated with tubercular ulceration of the intestines, to which it is then probably secondary, or with tubercular peritonitis. It is not improbable that the mesenteric disease may be primarily set up as the result of mere long-continued intestinal catarrh. The patient may be evidently scrofulous or tuberculous, but this is by no means constant, and there may be no signs whatever of any such diathesis. The disease may also be accompanied with pulmonary phthisis, although this is comparatively rare in children, and the lung-affection is almost always secondary in these subjects. In adults, on the other hand, tubercular disease of the lacteal glands, when it does occur, is in the large majority of cases a complication of pulmonary phthisis, intestinal ulceration being present at the same time.

The changes in the glands are similar to those characteristic of the scrofulous process in the lymphatic glands, namely, a hyperplasia of the cellular structures, of low vitality, followed by caseation, and ultimately by calcification, should the case last sufficiently long; and it is usual in fatal instances to find these conditions more or less combined in different glands. Tubercle-bacilli have been detected. Occasionally some of the glands suppurate. Should recovery take place, all the involved glands may be converted into inert, chalky masses, in which condition they remain for an indefinite time. A case came under the writer's notice some years ago, in which, the patient having died from an independent acute illness, the mesenteric glands were found to be universally calcified, this being associated with scarring of the external glands, and other signs of past scrofulous disease, from which the patient had quite recovered; the condition of the glands was unattended with any symptoms whatever. The individual glands in mesenteric disease may attain a considerable size, and when they are agglomerated into a mass a distinct tumour is formed.

Symptoms.—It is frequently impossible to recognise definitely the symptoms, either local or general, immediately due to tubercular disease of the mesenteric glands, as they are combined with and masked by those resulting from intestinal ulceration and catarrh, from tubercular peritonitis, or from the implication of other structures. The digestive organs are usually disordered, and, even if there should not be intestinal ulceration, children who suffer from mesenteric disease are very liable to enteric catarrh. Hence diarrhœa, with unhealthy stools, is a common symptom, which it is often difficult to check, or it returns from very slight causes. In other cases the bowels are constipated. Scrofulous mesenteric glands do not seem to be painful in themselves, but colicky pains in connexion with the bowels are of frequent occurrence, and the disease of the glands may have some influence in exciting such pains. The abdomen is almost always distended and prominent, owing to the accumulation of flatus, and it may be markedly tympanitic. Hence, even when the glands are much enlarged, it is often impossible to feel them, but they may sometimes be made out by deep pressure with the fingers over the abdomen. In some instances the abdomen is retracted, and then the glands may be more readily felt. Signs of fluid in the peritoneum, or of chronic tubercular peritonitis, may be present. Peritonitis has also, in exceptional instances, been set up by suppurating scrofulous glands bursting into the peritoneal cavity.

The general symptoms in tabes mesenterica are usually very prominent, as evidenced by wasting, which may reach extreme emaciation, anæmia, debility, and pyrexia, marked hectic fever ultimately supervening in some cases. How far, however, the mesenteric lesion originates these symptoms is a matter of doubt, but it is highly probable that it accounts for them in some measure. Cases in which mesenteric glands are the seat of scrofulous disease differ much in their severity; and the symptoms may be so indefinite that it is impossible to make any positive diagnosis of its existence. A large number of cases prove fatal; but it must be remembered that even after severe symptoms recovery may take place, the glands becoming calcareous and inert. When the glandular affection is secondary to pulmonary phthisis, it helps to hasten the fatal termination.

Treatment.—This mainly consists in the treatment required for scrofulous disease in general, such as the administration of cod-liver oil, preparations of iron, quinine, and other tonics; favourable hygienic conditions and surroundings; change of air, especially to the country or to the sea-side; and other appropriate measures. The diet needs particularly careful attention. It should be nutritious and digestible, but has often to be modified so as to render it suitable for the condition of the alimentary canal. Remedies directed to the improvement of the state of this canal, or to the relief of symptoms connected with it, are also often required. No local application can possibly have any effect upon scrofulous mesenteric glands; but symptoms might be benefited by friction with some simple liniment, the application of a flannel bandage, or the use of dry heat, fomentations, or poultices in connexion with the abdomen, should occasion call for them. Any secondary morbid conditions which may arise must be attended to. Paracentesis may be demanded for ascites.

3. **Hypertrophy.**—It will suffice to remark under this head that the lacteal glands are liable to be more or less hypertrophied in cases of lymphadenoma, and in the form of leucocythæmia attended with glandular enlargement. The writer has met with instances where the growth was very considerable. They might possibly be detected during life by physical examination, or they might cause symptoms by their mechanical effects; but, as a rule, their existence is only ascertained at the *post-mortem* examination.

4. **Atrophy and Degeneration.**—The mesenteric glands atrophy in old age, and they may also become wasted and withered after previous disease, such as typhoid fever. The caseous and calcareous changes which they undergo in connexion with scrofulous disease have been already alluded to. It may happen that atrophic or degenerative changes in these glands affect the general condition; but it is certain that they may be extensively calcified, and yet the patient remain apparently in excellent health.

5. **Morbid Formations.**—The mesenteric glands may be the seat of *albuminoid* disease. It is said that they can then be felt through the abdominal walls, firm, distinct, and easily movable; but this is by no means always the case. *Cancer* is chiefly met with as a secondary formation, the lacteal glands being particularly liable to become affected if the intestine is the seat of malignant disease, and the localisation being determined by that of the intestinal lesion. It may occur, however, as a primary affection. The cancer is usually of the softer variety, but it will depend to some extent on the nature of any primary deposit. A considerable tumour may be formed, firm and nodulated; or the glands may remain separate. Physical examination often reveals the presence of the disease. Further, localised pain, with symptoms due to pressure, should it exist, together with evidence of a cancerous cachexia, and of the implication of other organs, especially of the intestines, constitute the clinical phenomena to be found associated with malignant disease of the lacteal glands. No treatment can be of any service except as a palliative.

FREDERICK T. ROBERTS.

MESENTERY, Diseases of. — *See* PERITONEUM, Diseases of.

MESMERISM. — DEFINITION. — The name of the process by which, rather more than a century ago, Anthony Mesmer, the deluded (or at all events the deluding) promulgator of the doctrine of 'animal magnetism,' induced the so-called mesmeric trance or sleep. *See* MAGNETISM, ANIMAL.

This mesmeric trance is identical with the condition now known as 'induced somnambulism,' or still more commonly as 'hypnotism' or the 'hypnotic state.' The condition itself is one which presents to the observer many highly interesting phenomena, and it, together with the means of inducing it, was first investigated in a full and scientific manner by James Braid of Manchester (1843).

In this place it is not intended to speak of the subject from its old point of view. The reader who desires to gain some notion of the errors, deceptions, and vain pretensions with which the whole subject was enveloped by those who have been content to style themselves 'mesmerists,' may with advantage consult the article on 'Mesmérisme,' by Deschambre (*Dict. Encycl. des Sc. Méd.*, tom. vii.), at the close of which they will also find a valuable bibliography. In that article the proceedings of Mesmer and his followers in France are fully exposed.

As a sort of transition between this old state of things, with its erroneous theory and vain pretensions, and the scientific standpoint taken by Braid in regard to the more correct limitation of the phenomena observable and their altogether intrinsic mode of production, came the observations of Elliotson in London, as conducted in the years 1837–38, when he sought to inform himself and others as to the phenomena and curative virtues of mesmerism. He encountered a storm of opposition, principally on account of his mode of dealing with the subject. He was unquestionably honest and enthusiastic in his search for what he believed to be truth; but he unfortunately did not, as Braid by his keener insight was enabled to do, reject and otherwise explain the so-called phenomena of clairvoyance, of transposition of the senses, and of prediction or prophecy. It is to be regretted, however, that Braid did not also reject all the so-called phenomena of phreno-hypnotism.

An independent practical study of the subject and of its therapeutic applications was shortly after the date of Braid's labours commenced by Esdaile in India (1846), as well as by J. K. Mitchell in the United States. They have more recently been succeeded by other investigators, amongst whom may be mentioned Girard Teulon and Demarquay (1860); Ch. Richet (1875); Charcot (1878); and also Weinhold, Beard, Preyer, Berger, Grützner, and Heidenhain (1880), Bernheim, and many others.

The induction of the hypnotic state or sleep has hitherto been possible in only a certain, but variable, percentage of the persons with whom trial has been made, though a successful result has been much more frequent with women than with men. According to Richet, however, the operator should not be discouraged by the failure of his first attempts with the same person; as persons may succumb on the fourth or fifth trial, and subsequently prove thoroughly good subjects for experimentation. Persons

who have once been hypnotised can in general be again brought with comparative ease into the same condition, and the facility of hypnotising such persons goes on increasing after each operation, owing to the existence of a predisposing mental state. A condition of excited expectancy is indeed a decidedly favouring mental state, though one which is not essential, since, according to Braid, Heidenhain, and others, even male adults who have heard nothing on the subject, and do not know for what purpose they are being experimented with, can often be hypnotised.

In persons who are favourably disposed for passing into the hypnotic state, the condition is easily induced by weak, long-continued, and uniform stimulation of the nerves either of sight, of touch, or of hearing. This state is, on the contrary, almost always easily capable of being abruptly terminated by some strong or suddenly varying stimulation of the same nerves.

Many of the lower animals, such as frogs and fowls, can be thrown into an extremely similar condition as a result of certain sudden and powerful sensorial impressions. Preyer distinguishes the state into which they are thrown by a different name, namely, 'cataplexy,' because the mode or physiological process by which it is induced seems to be different from that by which hypnotism is caused.

The hypnotic state or sleep is one which varies much in intensity in different persons, and in the same person at different times. The principal phenomena that are exhibited or which can be detected in hypnotised persons are the following: (1) imitation movements; (2) exaltations of special sense; (3) illusions and hallucinations; (4) analgesia, general or unilateral, or even a condition of hemianæsthesia, general and special; (5) increased reflex irritability and tonic spasms of the voluntary muscles; and (6) other miscellaneous phenomena, such as spasm of the accommodation apparatus in the eye, dilatation of the pupils, increased rapidity of respiration and of the pulse, together with profuse perspiration.

According to Charcot, when hypnotism occurs in hysterical subjects more especially, it is divisible into three states, definitely related to one another, though not always occurring in the same order. He says: 'These different states which, taken as a whole, include all the symptoms of hypnotism, may be referred to three fundamental types: first, the cataleptic state; second, the lethargic state; and third, the state of artificial somnambulism. Each of these states, including, moreover, a certain number of secondary forms, and leaving room for mixed states, may be displayed suddenly, originally, and separately. They may also, in the course of a single observation, and in one subject, be produced in succession, in varying order, at the will of the observer, by the employment of certain methods. In this latter case the different states mentioned above may be said to represent the phases or periods of a single process.' For details concerning this and the many other points of importance in connexion with hypnotism, the reader should consult Binet and Féré's work on *Animal Magnetism* (1887), in the 'International Scientific Series.'

A discussion of the mode of production of these several phenomena, or of the exact nature of the hypnotic condition itself, would lead us into details too purely physiological for our present purpose; suffice it to say that the hypnotic state, in one or other of its stages, seems to be akin to that met with in some sleeping persons, as well as to the states known as trance, somnambulism, and catalepsy, and that its physiological cause is presumed by Heidenhain to be some inhibitory arrest of activity of the ganglion-cells of the cerebral cortex, or, as the writer would rather put it, of certain tracts of these ganglion-cells, varying in their nature or situation in accordance with the different stages of the hypnotic condition that may exist. (See *Animal Magnetism: Physiological Observations*, by R. Heidenhain, 1880.)

The scientific study of the phenomena presented by hypnotised persons is unquestionably of great interest and importance, from the point of view of the higher cerebral physiology. But whether the systematic induction of such a state can ever be used as a legitimate or potent means for curing disease, or even for the alleviation of certain distressing symptoms, must be left for the future to decide. The investigations that have been made in recent years are far from being decisive in favour of the method as a remedial agent, especially when taken in conjunction with the actual harm which may result from its induction in some nervous and impressionable persons. The good use to which it was put by Esdaile in India, as a means of inducing insensibility during surgical operations before the general introduction of chloroform, ought, however, never to be forgotten. (See his *Mesmerism in India, and its Practical Application in Surgery and Medicine*.) The whole subject is one of great interest for the practitioner of medicine, and for the psychologist, now that the absurd theories with which its early history was shrouded have been got rid of. We must be careful, however, to pursue the study of the condition itself in a strictly scientific manner, and watch lest the too ready adoption of hypnosis or Braidism as a curative agent may do harm rather than good—and that not to the patient only, but also to the practitioner. One thing seems now to be

very generally admitted, and that is that public exhibitions of the effects of hypnotism by non-medical persons are most unadvisable and capable of doing much harm. They ought undoubtedly to be made illegal in this country. Such steps have already been taken in France, Belgium, and elsewhere. H. CHARLTON BASTIAN.

MESOLOGY (μέσος, between; and λόγος, a discourse).

This term, suggested by Bertillon, conveniently expresses the investigation of the mutual relationships existing between living beings and their surroundings.

The physiological life of any organism may be regarded as the resultant on the part of the tissues of two sets of influences—intrinsic or hereditary, and extrinsic. To the former are due those structural, and consequently functional, characteristics which are common to ancestors and progeny alike, whilst the fluctuating nature of the environment determines those variations which distinguish different species. Within certain assumed limits these stimuli are regarded as normal, and the resulting manifestations of the tissues are said to be healthy; whilst disturbances in either of these groups of influences constitute the causes of disease—that is, abnormal function dependent on abnormal structure, which in its turn has been brought about by a change in the usual conditions under which it exists.

Mesology, therefore, may be looked upon in a restricted sense as a branch of ætiology, dealing, as it does, with such factors as temperature, atmosphere, climate, locality, food, clothing, and the more subtle agencies of habit, profession, domesticity, mental states of depression, excitement, or irritation; in short, with any and every circumstance, whether material or psychical, which acts upon the body. W. H. ALLCHIN.

METALLIC.—A peculiar quality of sound, which the name suggests, either elicited by percussion or heard on auscultation, especially in connexion with certain adventitious sounds in pulmonary cavities. *See* PHYSICAL EXAMINATION.

METAMORPHOSIS (μετά, a preposition signifying change; and μορφόω, I form). In a pathological sense this word signifies a form of degeneration, in which one tissue or substance becomes chemically changed into another, as, for example, albuminous structures into fat. *See* DEGENERATION.

METASTASIS }
METASTATIC } (μεθίστημι, I change place).—These terms are supposed to imply the translation of a disease from one part of the body to another, such as seems to occur occasionally in gout, rheumatism, mumps, and certain affections of the skin and mucous membranes. Modern pathology, whilst admitting the existence of the phenomena to which the term 'metastasis' has been applied, refuses to accept as satisfactory the explanation of the fact implied in the term.

METEORISM (μετεωρίζω, I raise up).—A synonym for tympanites. *See* TYMPANITES.

METRALGIA (μήτρα, the womb; and ἄλγος, pain).—Pain in the womb. *See* WOMB, Diseases of.

METRITIS (μήτρα, the womb).—Inflammation of the womb. *See* WOMB, Diseases of.

MIASM (μιαίνω, I pollute).—This term has been used very vaguely in reference to poisonous emanations generally, but its application ought to be limited to the malarial poison. *See* MALARIA.

MICRO-ORGANISMS.[1] — SYNON.: Microzymes; Fr. and Ger. *Microbes*.—Under this term will be considered those minute organised bodies which are found associated with various morbid states. Strictly speaking, the term might be applied to any living body of microscopic dimensions, but in medical parlance it has come to be limited to those which may be associated causally or otherwise with disease. And it is even more restricted, for it is generally understood to mean only such organisms as are presumably of vegetable nature. Hence it is largely synonymous with Bacteria, although it may perhaps be extended to some other lower fungi and algæ. The term 'microbe' will here be used synonymously with 'micro-organism.'

PRELIMINARY REMARKS. — The rapid development of bacteriological literature, and the enormous amount of work which has been done in the subject during the past few years, render it extremely difficult to concentrate within a small compass so much of the ascertained facts as may be most useful to the practitioner. A vast army of investigators have been and are engaged in its study; and whilst there is no kind of scientific investigation which demands more rigorous precautions in experiment, and more caution in inference, it is certain that a large number of observers have been too ready to announce supposed discoveries. Hence it is a matter of extreme difficulty to do justice to work of real value, or to disentangle the true from the false. Nor can the facts which are of ascertained value be readily condensed into a small compass without risk of error. It

[1] This article was written conjointly by Professor Greenfield and Dr. Robert Muir. The only exception is the section on Anthrax, for which Dr. Muir is solely responsible. The illustrations were drawn by Mr. Richard Muir, under the direct supervision of Professor Greenfield, and are, with three exceptions, from specimens prepared in his laboratory.

seems therefore best to devote especial attention to the present standpoint of the subject and the modes by which it is studied, and only to outline briefly those parts in which our knowledge is at present liable to rapid modification.

Theoretically, disease might be produced by the introduction into the system of a poison or ferment generated outside the body, and acting as any other poison. But in order that it might be contagious to other individuals, it is essential that the poison should be reproduced in like form within the body. The conditions which we know to be present in contagious and infectious diseases can only be satisfied if the virus is itself capable of development and activity within the body, reproducing its like.

The study of fermentation, and especially the remarkable investigations of Pasteur on organised ferments, presented at first an analogy to, and afterwards an illustration of what we know to occur in contagion. All subsequent work has been a study of the nature and mode of action of mycotic contagia.

But in order to a full knowledge we require to know—the nature and characters of the contagium; its conditions of introduction and of activity; its mode of reaction in the production of the phenomena which we group as 'disease'; and, lastly, the manner in which it is eliminated from the body, and the modes in which the living body protects itself from its action. Our knowledge up to the present time is very largely that of the nature and characters of the contagium, although there is now marked progress in the other branches of the study.

It may be well to indicate briefly the grounds on which any micro-organism can justly be regarded as the contagium or actual cause of disease, according to the admirable canons laid down by Koch.

1. It must be constantly associated with the disease, being present in the fluids or tissues of the diseased animal, and in the virus by which the disease is communicated.

It may indeed be in a different form in the virus, *e.g.* in the form of spores, whilst in a more developed form when in the full activity of disease-production.

And we should expect that if there is a special characteristic lesion, such as an eruption, or some special affection of one or more organs, for example, the spleen, the organism should be especially found there. This, although proved to be the case with regard to several diseases, is not theoretically essential, *unless the virus of the disease especially resides in the specific lesion*—as in the vaccine vesicle, or in the glanders or syphilitic sore.

2. The constant presence and association of a definite organism is not of itself sufficient to prove that it is the virus. For it may be only a part of it, or may be an accidental accompaniment. And we also know that there are constantly in the air we breathe, and in other places, very numerous and varied organisms, which may under suitable conditions enter the body, and which can do so when the normal resistance is lowered; and which might therefore be found wherever any disease-process was going on.

It is, therefore, further essential to proof, that the organism should be capable of absolute isolation and separate cultivation outside the body, and that then, being introduced into the body, it should produce the same disease and be capable of retransmission to other individuals.

It is obvious that this rigorous scientific proof is almost solely capable of being attained in the lower animals, seeing that we cannot, in the more serious diseases, thus experiment on man. And even in the lower animals we meet with numerous inherent difficulties, which may be briefly considered.

(1) Some micro-organisms can be cultivated outside the body only with great difficulty, others at present not at all. Yet the early difficulties in this respect are being largely overcome.

(2) The specific disease-producing properties may be greatly diminished, or even lost, when the organism is cultivated outside the body. Here, again, by careful adaptation of the conditions of artificial culture, this loss of activity may to a considerable degree be prevented.

(3) A further difficulty, which forms an especial barrier to the study of human diseases, is found in the fact of the variations of disease when communicated from one class of animal to another, and in the relative degree of susceptibility to disease of different classes, or even of species or individuals of a given class. Thus we shall find (*a*) that a virus which causes a general blood-poisoning in one class of animals, will produce only a local eruption in another, and (*b*) neither may correspond with the disease as we are familiar with it in the human subject. Only a very careful study and comparison in a large number of cases can suffice to show what is the corresponding disease; for instance, if a specially characterised sore is found to be produced by inoculation of one class of animals with the disease of another class.

Again, (*c*) some human diseases are transmissible to animals only with difficulty, or not at all. Or, amongst a number of animals experimented on, only a few may be susceptible, the others having a natural or acquired immunity. Some of the animals most readily obtained for experiment are peculiarly unsuited for the purpose, particularly rabbits. A vast number of fallacious discoveries have been due to the too frequent employment of rabbits, it being assumed that because they

have shown various indications of disease, such as fever, the virus employed had some specific characters.

It may be thought that these elementary facts have been too much dwelt upon. But experience has shown that the intense desire for discovery, and too eager emulation, have enormously hindered true advance in this branch of science; and the medical public at large should insist on proof of a more rigorously scientific nature. But such rigorous proof is not always attainable. We may, then, be provisionally content with a less exact knowledge as a guide to practice and further experiment. If by strong analogy in all essential points a disease comes into the group of contagious specific diseases, and is strictly comparable with one in which a bacterium has been proved to be the actual virus; if, further, there is constantly present in the body, and especially if in the specific lesion and in the virus, an organism having definite characters, we may provisionally regard it as the essential contagium. And still more may we do so if we find that the disease can be transmitted with the same characters to another individual by employment of fluid or tissue which contains this organism, and that it is not transmitted if the fluid or tissue employed for inoculation does not contain the specific organism, although derived from an animal suffering from the disease and containing the organism in other parts.

Our most complete and absolute knowledge is, of course, that of some diseases which are peculiar to lower animals, yet are so closely analogous to some human diseases that they may be accepted as evidence with regard to the latter.

It will be found that, at the present time, we have conclusive evidence of the bacterial nature of the virus in only a small number of human diseases; that in a considerable number we have the secondary kind of proof; whilst in a much greater number our knowledge is as yet fragmentary, and lacks on one or other side the completely conclusive evidence.

Of the diseases affecting man, anthrax and tubercle may be mentioned as good examples of the absolutely proved. Leprosy is one in which the final proof of inoculation of isolated cultures is yet wanting, but is the only missing link. Relapsing fever is an instance of inference from transmission of the organism and the fever to monkeys. Syphilis is an example of evidence from analogy only, although some of the organisms discovered may eventually prove to be the virus. In the case of traumatic tetanus recent discoveries appear to leave no doubt of its bacterial origin.

Morphology and Life-History of Bacteria.—In the consideration of bacteria it is well to regard as a separate order the forms which show a higher degree of complexity and greater variation in the forms or stages of development under different conditions of life—such as the groups Cladothrix, Crenothrix, and Beggiatoa. They have been included by some botanists under Bacteriaceæ, but may more properly be regarded as constituting an order or orders somewhat higher in the grade of vegetable life. This arrangement has at any rate the advantage of simplifying the descriptions of the life-history. Moreover, with the exception of the Actinomyces, which has been shown to be a Cladothrix or allied form, none of these orders are known to be concerned in the production of disease.

General characters of bacteria.—Bacteria are unicellular organisms, belonging to the lowest class of chlorophyll-less [1] algæ, and constituting the most elementary and lowest form of vegetable life. They multiply by fission, hence the name Schizomycetes; but for many of them there is also a mode of propagation or reproduction by the formation of *spores*.

In structure they consist of a protoplasmic body, the protoplasm having peculiar chemical and physical characters (*mycoprotein* of Nencki), and a cell-envelope, composed of a carbohydrate allied in composition to cellulose. Whether the cells are nucleated is at present an open question. The protoplasm is frequently granular, showing differences in the staining reactions in different parts; and, in addition, granules of distinct chemical qualities have been detected in some of the higher forms (*e.g.* sulphur in Beggiatoa). The irregular staining may perhaps indicate some definite structure. Moreover, marked changes affecting the entire cell may be observed during the process of spore-formation. Further, various degenerative changes may lead to alterations in the staining reactions, and to the formation of granules of apparently oily nature, or to irregular swelling with formation of so-called vacuoles. The tendency to such changes and the form which they take vary with different species, and may give special characters to the particular species. The forms when thus altered are sometimes known as degenerated or *involution* forms.

The variety in the chemical reaction, especially the staining reaction of the protoplasm in different species, is an important aid to their recognition, *e.g.* the tubercle-bacillus.

The *cell-envelope*, which can be detected with certainty only in some of the larger forms, and is inferred to be present in others from the associated characters, can be brought into view by reagents, such as iodine, which cause shrinking of the protoplasm: or in some cases by staining. It is highly flexible. Its thickness is very various; and it possesses, especially

[1] Some bacteria are now said to contain chlorophyll granules, but the general fact is as stated.

in some species, a great tendency to swell and undergo partial solution, or rather to form a gummy or jelly-like material, like gelatine or gum-tragacanth when soaked in water.

To the partial solution of this material is due the hyaline 'capsule' which is characteristic of some bacteria (*e.g.* the pneumono-coccus of Friedländer), and the intercellular substance of 'zoogloea' masses, by which the masses adhere to surrounding objects and cohere into a sticky mass.

Motility.—Many bacteria are spontaneously motile; indeed, the property is so common in several of the species associated with decomposition in organic fluids, that it was at first thought to be almost universal. But we now know that many never display this property.

Where present, it has in several species been long known to be associated with the presence of cilia or flagella, whilst in others no cilia could be detected, and it was believed that the movement of the cell-body itself sufficed to produce independent locomotion.

FIG. 68.—Finkler's Spirillum and Koch's Cholera Spirillum, both prepared in the same manner, stained by Löffler's method, to show flagella; and placed side by side for comparison. × 2,000 diam.—*a.* Finkler's Spirillum. From a culture made in the Pathological Laboratory, Univ. Edin. *b.* Koch's Cholera Spirillum. From a specimen from the Berlin Health Laboratory.

But from recent researches by a method devised by Löffler (for details, see *Staining of Bacteria*), aided by photomicrography, we know that flagella are present in several forms where they were hitherto invisible, for instance, the cholera spirillum; and we are not as yet entitled to assume their absence in other motile forms.

The flagella are apparently continuous with the cell-envelope; whether with the cell-protoplasm also is not certain.

Forms of the cells.—The cells are spherical, ovoid, or cylindrical, and usually symmetrical. They may be in short cylinders, bulged in the centre and somewhat pointed at the end (*clostridium* form). The cylinders may be short or long rods, straight or slightly curved (*bacillus* form), or much curved (*spiral* form). They may grow into long threads, straight, or curved, or twisted (*leptothrix* form, *vibrio* form, *spirillum* form, &c.), and appear to be homogeneous throughout; but in most cases we may by reagents discover that the apparently uniform thread is composed of cells arranged endwise, but remaining attached to each other. Such elongated forms are especially seen when growth occurs in fluids at rest.

FIG. 69.—Spirillum Undula.—From a culture, stained by Löffler's method for showing flagella. The various forms and stages, and also the variety in number of the flagella, are seen. × 800 diam.

Position and arrangement of flagella.—Flagella have been discovered in several of the rod and spiral forms, and in one species which is spherical or nearly so (*Micrococcus agilis* of Ali Cohen).

In some of the lower and simpler forms (*i.e.* excluding Beggiatoa, &c.) the flagella are terminal and single only at one end of the cell; but in some there is one flagellum at each end. More rarely, two or more are present at one end. They are often long, and may greatly exceed the cell in length. They are usually of extreme tenuity (*e.g.* $\frac{1}{8}$ to $\frac{1}{4}$ the diameter of the cell in the cholera bacillus), and hence are detected with great difficulty.

In typhoid bacilli, in which Löffler was unable to detect flagella, a very remarkable condition has been discovered, namely, the presence of multitudes of short lateral cilia along the entire length of the cells. A similar condition has also been more recently detected in one or two other species.

Colouring matters.—Many bacteria, when grown in mass, show distinctive colours—red, yellow, brown, &c. These may develop only in certain conditions of growth, or in parts exposed to the air. On examination with the microscope, the pigment may appear to be in the cells (as in magenta micrococcus); but it is readily dissolved out, and would appear in most cases to be an excreted or formed product, which mainly lies in the intercellular substance, staining the cell wall. Or it may in some be the

product of some substance excreted by the cell acting on the culture-medium, and especially in presence of oxygen.

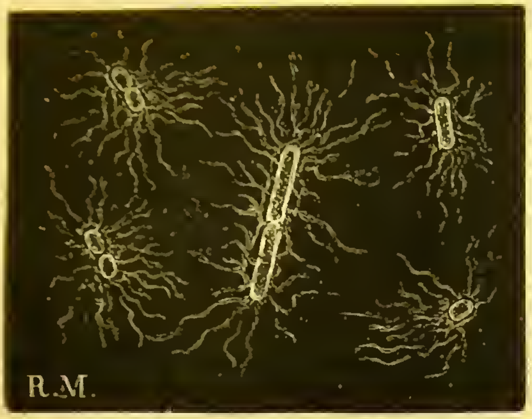

FIG. 70.—Typhoid Bacilli.—Stained to show cilia: × 2,000 diam. From a specimen prepared in the Berlin Health Laboratory.

Multiplication and fission of the cells.—Division occurs by fission, usually dichotomous, the segments being often of nearly equal size. This is usually preceded by elongation of the cell, so that in the spherical forms, as fission becomes complete, each of the new cells is nearly spherical before separation occurs. Transverse fission is the rule in the simpler rod and the spiral forms. But in some spherical forms it may take place in two planes at right angles to one another, hence forming tetrads (as in *M. tetragenus*, *M. gonorrhϾ*); or, further, in three different planes and directions at right angles to one another, forming a bale-like mass (*sarcina* form).

During the process of fission, a constriction may appear at the line of approaching segmentation, or none may be seen; hence different characters, especially in the elongated forms. The first cells may remain united in chains, threads, or groups, and may thus give special characters, from which names have been derived. But since such persistent union is inconstant, varying with the conditions of growth, and best seen in quiescent growth in fluid or semi-fluid media, it should not be regarded as other than a subordinate character. For example, all micrococci, if growing freely and kept in motion, must become 'diplococci' during the stage of division.

In bacilli the cells elongate, and if the segments do not separate they come to form threads. These threads do not form false branching, as occurs in the case of cladothrix.

Spore-formation.—The production of spores, and the properties with which these are endowed, are amongst the most important facts concerning bacteria. Discovered at first in some of larger size, such as the hay bacillus and anthrax bacillus, by Koch, the process is now known to be common to many of the straight, and some of the curved rod forms. For the latter there is less evidence, and the question is at present unsettled for most spherical forms. But from known facts in the life-history of many species in which the existence of spores is not proved, there is strong probability that for all the rod forms, and very possibly all curved and spherical too, there is a like capacity, given favourable conditions of life.

FIG. 71.—Cladothrix dichotoma. From a culture. × 800 diam.

The process of spore-formation takes place only under certain favourable conditions, and may be prevented by growth under unfavourable conditions, especially of temperature. It was formerly believed that spore-formation occurred especially when the nutriment was deficient, but there is now no question that it is a normal phase of their life, occurring especially under certain favouring conditions of growth.

Mode of spore-formation.—This can best be studied in some of the larger bacilli, such as the *Bacillus subtilis* and *B. anthracis*. The protoplasm of the cell appears to undergo condensation, its more solid portion becoming agglomerated and retracted, usually towards one end of the cell. At the same time it becomes more highly refracting, and often assumes different staining properties. The remainder of the cell may appear hollow or granular, but this is not always the case. Swelling may and frequently does take place at the site of the spore, so that the rod appears beaded. This swelling may be so considerable that the diameter of the spore may be twice as great as that of the rod, or more (*e.g.* tetanus bacillus). This fact is very apt to be exaggerated, owing to the different refraction of the spore and the rest of the protoplasm, which renders it difficult both to estimate and to photograph.

The spores are usually ovoid, more or less elongated, sometimes nearly spherical. When formed within bacilli arranged in chains, it commonly happens that the spores are situated one at the end of each cell, and

in such a manner that the cells form pairs with the spores at the adjacent ends. If now division of the cells takes place between the adjacent spores, rods imperfectly divided

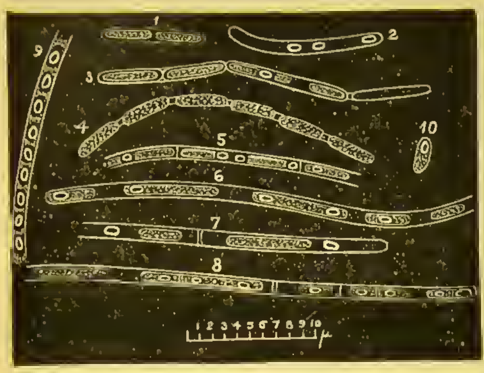

FIG. 72.—Stages in the Growth of a Bacillus, and of Spore-formation.—(1) Bacillus as seen before division; (2) Undivided bacillus showing spores; (3) Thread formed of segments, which have not separated; (4) Another of the same; (5) Part of a long filament, showing the lines of cleavage; (6) Another filament, showing aggregation of the protoplasm, and commencing spore-formation, without any sign of segmentation; (7), (8), and (9) show other appearances in undivided filaments; (10) Bacillus in process of growth from a spore. × 1,500 diam.

will be formed with a spore at each end; if at the end distal to the spores, a pair of spores will be seen near the centre of a rod. When the division is complete, each rod will contain a single terminal spore.

This fact, trivial as it may appear, is important to note, since distinctions of specific value have been adduced from this common fact.

Much less frequently the spores are situated towards the centre of the cell, or, in an apparently undivided rod, at irregular intervals. All these modes of arrangement may be seen in the same species, and they have no specific value.

Structure of the spores.—Beyond the facts that they consist of a highly refracting protoplasmic mass, with great endowments of vitality and peculiar staining reactions, surrounded by a capsule or cell-wall resembling that of the parent cell, but of greater resisting capacity, we know nothing. That they have an intimate organisation we suppose from what we know of other cells.

Staining reactions.—It has already been stated that the staining reactions of the spore protoplasm differ from those of the cell protoplasm, and may do so to a remarkable degree. By selective staining the spores may be stained of a different colour from the rest of the cell. And it may here be mentioned that in one of the common bacteria of water the spores show normally a definite coloration of a reddish tinge (*Bacillus erythrosporus*), when examined fresh, without staining.

Germination.—When placed under favourable conditions the spores germinate, and reproduce cells like those from which they originated. According to some, this takes place by a sprouting through the capsule; whilst others allege that the entire spore elongates to form the new cell, which then multiplies by fission. Except as possibly giving a clue to the structure of the spore, the question is unimportant. What is of consequence is that the spore always gives rise to cells like those from which it sprang.

Vital capacity of spores.—The remarkable power of resistance of the spores of many species will be referred to under the life-history in general, and in relation to particular species.

CLASSIFICATION OF BACTERIA. — We are now in a position to refer briefly to the classification of bacteria. Many attempts have been made to arrive at some satisfactory division, but hitherto with very limited success. The difficulty arises in great measure from our defective knowledge of their complete life-history, and of the variations which they may show under varying conditions of growth. Most of the attempted classifications are valueless for our purpose, and are also unscientific. The only true basis is of course a botanical one, and such properties as the production of colour, of fermentation, or of disease are useless, unless as provisional. We may therefore omit all mention of these. For the more recent scientific classifications botanical works may be consulted. For our purpose it is sufficient to adopt the nomenclature usually employed, it being understood that the names given are merely convenient appellations, and not scientific distinctions.

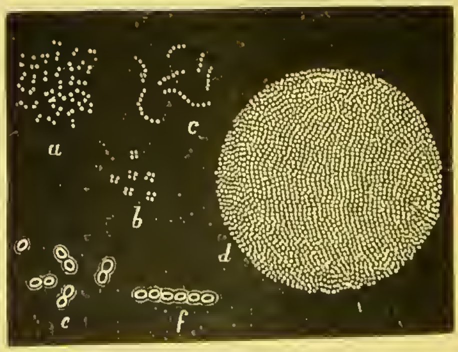

FIG. 73.—(*a*) Single and double micrococci; (*b*) groups of four, 'sarcina' form; (*c*) chains; (*d*) zooglœa; (*e*) single and double micrococci, more highly magnified, showing process of division; (*f*) a chain, more highly magnified.

The basis of this nomenclature is the form of the cells, and the arrangement commonly seen in their growth:—

(1) Spherical or slightly ovoid cells. *Cocci* or *Micrococci*—

Cells usually in pairs—*Diplococci.*

Cells in chains—*Streptococci.*

Cells in groups of four—*Tetragena* or *Tetracocci.*

Cells in bale-like masses, comprised of groups of eight—*Sarcinæ.*

Cells in masses or balls—*Staphylococci.* (Grape-bunch like.)

(2) Elongated, rod-shaped, or thread-like cells—*Bacilli.*

(3) Curved rods or filaments—*Spirilla.*

Various names have been employed to distinguish abruptness of curve, length, &c., as Spirochæte, Leptothrix, &c., but they are of no practical value.

But, whilst these names suffice for our purpose, it must be understood that, in dealing with bacteria as a whole, much more elaborate distinctions would be essential.

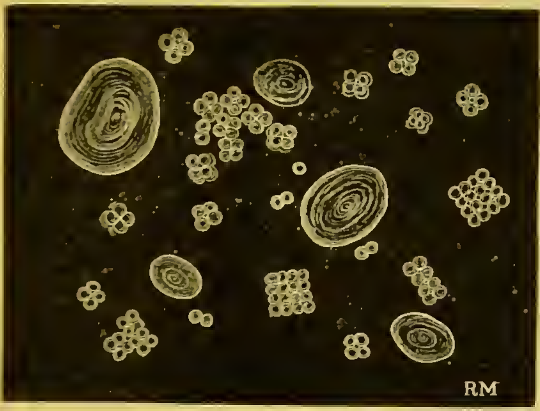

Fig. 74.—Sarcina ventriculi. Showing sarcinæ and starch-granules in vomited matter. × 400 diam.

Constancy of Species. — *Variation or transmutation.*—Amongst the very important questions which underlie the subject of the pathogenic activity of bacteria, is that of the constancy of species, the possible variation under cultivation, and the acquisition or loss of specific activity.

If marked variation or transmutation can occur, and if one species can not only pass into another, but can under varied conditions of life assume different capacities for fermentative and like activities, then not only is the subject rendered far more complex, but the relation of bacteria to virulent diseases is put on an entirely different footing. For they may be not so much the essential virus as the carriers of contagion, carrying in, as it were, a catalytic process from one individual to another. If, for example, a common bacterium, innocuous in itself, were liable, when grown in the blood of an animal suffering from some disease, to carry on the ferment-like activity of similar kind to another animal, it is obvious that the bacterium is not the specific virus. It simply transmits a process. Analogies to such a process may be found even in that of crystallisation. But if one species can do this, another may also; and so a similar disease-process might be secondarily induced by a variety of bacteria.

Two questions then arise : Are the species essentially and persistently distinct? Are the specific pathogenic activities innate or acquired?

Variation of Species.—From what we know of the variations of low organisms under cultivation, we should anticipate a high degree of capacity for variation or mutation in bacteria. Nevertheless, the amount of such variation appears to be small. For we find that a large number of species, which have been cultivated through hundreds of generations, not only maintain their morphological characters, but produce like effects as to colour production, fermentative changes in the cultivating media, and even pathogenic results. It has already been mentioned that differences are observed in the characters when grown under different conditions, but these do not impair the reproduction of the original characters when sown again on the original soil. Some characters, such as colour production or special fermentations, may only appear when special conditions are present.

It must, however, be stated that the pathogenic activity is capable of diminution or loss, and, conversely, of intensification, as will be seen in some cases to be mentioned. But this appears to be explicable rather on the hypothesis of acquired habit of growth, than of actual alteration or loss of capacity, and in some cases is associated with lowered vitality of growth. When re-acclimatised in the body, the virulence may be speedily regained. There is further the question whether great mutations of form, from spheres to threads, from these to spirals, and the presence or absence of cilia in the same species under different conditions, do not militate against the view of the specificity of bacteria. The answer to this is that in the lower fungi not only are great differences of form observed in the same species at various periods of life, but that two or even more modes of reproduction normally occur in some which have been carefully studied—resting spores and motile or free-swimming spores, for example, as in Saprolegnia. The discovery, then, that a species of bacterium exhibits great variety in its form, &c., at different periods of life, only shows that it belongs to one of the higher groups, in which such cyclical changes are part of the normal life-history. It is partly on this account that the lower forms, with which we are mainly concerned in disease, should be kept distinct from the higher groups in which such multiplicity of form is normal.

Temperature in Relation to Growth.—The temperature of cultivation has been

shown by numerous observations on many species to have a most important bearing not only upon the rapidity of growth, but also upon the phases of life and the reactions of the organism. More especially spore-formation may occur with certainty and readiness only under particular conditions of temperature. An example of this is found in the tetanus-bacillus. But there can be no doubt that some of the statements which have been made on this point have given too rigid a limit to the possible temperature-range. For example, it has been alleged that the tubercle-bacillus can only grow at a temperature of at least 37° C. outside the body, but this is no doubt an error. In order to successful growth under unfavourable conditions, some of the more markedly parasitic bacteria do require a regulated temperature not lower than that of the human body.

Speaking generally, those bacteria which are normally concerned in fermentations and decompositions, and are only accidentally or potentially parasitic, grow most actively at a range of 17°–25° C. (about 60°–77° F.), and better over 70° F.—a normal summer temperature. Those which are most definitely parasitic, such as tubercle and anthrax, thrive best at 35°–40° C. (95°–104° F.). Some of these, however, can be readily grown at ordinary temperatures, such as typhoid and anthrax, whilst others require to be carefully incubated at the higher temperatures (*e.g.* tubercle, diphtheria).

At the lower temperatures spore-formation may not occur, or may be very slow; thus anthrax bacillus is said not to form spores below 20° C. (68° F.).

Resistance of Bacteria to Temperature.—Not only the temperature of most active growth, but also that of the death-point, differs for different species, and at different stages of life. Speaking generally, the spores, when fully formed, show a far greater capacity for resisting both heat and cold.

The death temperature of several species has been carefully studied. With few exceptions, even spores are entirely killed by exposing to a moist heat (steaming water) of 100° C. for a few minutes. But in some as long as half an hour may be necessary, and in some even an hour, in a current of steam.[1] Superheated steam of 110°–120° C. is rapidly and invariably fatal even in a few seconds.

Dry heat is far more variable in effect and less active, especially if the spores have been first allowed to dry thoroughly. Dry heat kills spore-free bacteria in an hour and a half of a little over 100° C.; spores of moulds, an hour and a half of 100°–115° C. A temperature of 130°–140° C. may be borne for some hours without completely destroying all spores (*e.g.* spores of anthrax bacilli); but this is only true of a few, so far as is known.

On the other hand, most spore-free bacteria, or bacteria in which the formation of the spores is incomplete, are readily killed by much less elevated temperatures, and may perish at 50°–60° C. Some few are known still to grow at 60°–70° C.

The heat-resisting capacity of the same species is also found to vary in different cultivations, the degree of vitality at different ages evidently undergoing modifications.

On the other hand, the resistance to cold is equally great. The spores of some bacteria, and the cells of some micrococci, are not destroyed even by the most intense cold.

The freezing death-point is difficult to determine for spore-free bacteria, owing to the difficulty of excluding the results of physical changes in the media, and also of ensuring the entire absence of spores; but freezing kills many, and alternate freezing and thawing may also kill some spores which are not killed by freezing (Prudden).

These studies have, it need hardly be pointed out, a most important bearing upon the subject of disinfection.

Alternations of Temperature.—*Tyndall's sterilisation method.*—Bacteria when in fluids are seriously injured by extreme alternations of heat and cold. Thus, if a cultivation be heated to 58°–60° C. (136·5°–140° F.) for half an hour to two or three hours, and then allowed to cool to the ordinary temperature, 17°–20° C., and if the process be repeated on the following three or four days, nearly all bacteria, whether spores or cells, will be killed, and the fluid will be 'sterile,' or bacterium-free.

It is supposed that the mechanism of this process is that the cells present are destroyed by the heat; and that the spores germinate, and the cells developed from them are on the following or successive days destroyed also. But some facts lead us to doubt whether this is the entire explanation, for the destruction occurs whether they are in a suitable soil or no, and alternations of freezing and thawing have a like effect.

It must also be mentioned that, whilst most bacteria, when spores have not been formed, are killed by a temperature of 60° C., *e.g.* typhoid, glanders, cholera, and tubercle bacilli, some require a higher temperature; thus, *Staphylococcus pyogenes aureus* requires 80° C.

Other Conditions Unfavourable to Growth.—*Exposure to direct sunlight* has a powerful influence in arresting the growth of bacteria, as of many other of the lower fungi. Actual death may occur, or the processes of development and spore-formation may be arrested or prevented. *Deficiency of nutriment* has a like effect. So also has *deficiency of oxygen* in aërobic species, oxy-

[1] A recently described potato-bacillus required four hours of steaming at 100° to destroy spores.

gen being essential to spore-formation in them. On the other hand, the presence of *free oxygen* may be equally deleterious to some which are anaërobic, especially some of the putrefactive species. The *presence of free acid* is found to be incompatible with growth in many, if not most, bacteria, whilst it is alleged that mould fungi flourish equally or better in an acid than in an alkaline or neutral medium. Further, many bacteria generate, as by-products, substances of 'antiseptic' nature, such as some of the coal-tar group, and these, if produced in sufficient quantity, and not removed, may arrest growth.

From these facts in relation to nutriment and temperature the conditions under which artificial culture must be carried on can be readily deduced. We must have a medium which contains nutriment in a moist or fluid form, with free access of oxygen, or in some cases (anaërobic) with its exclusion, and a suitable temperature must be maintained. The nutriment should contain proteid substances; and, if possible, some of these should be in forms in which they are readily broken down—hence the use of prepared peptone.

Modes of Study.—For the complete study of micro-organisms, various modes of investigation may be followed. The microscopic characters, even when aided by special staining reactions, do not afford a sufficiently satisfactory means of discrimination between allied forms. Nevertheless, when these characters are very peculiar, and when the organism is found in constant association with a peculiar change, as in the case of the tubercle-bacillus, its identification in the tissues is comparatively easy.

The sources of fallacy in microscopic study are briefly these:

(1) The very minute size of many microbes makes the more delicate points of difference hard to appreciate with our present powers, and slight failure in preparation may especially obscure them. Hence able investigators have described the same organism with quite different characters—a bacillus as diplococcus.

(2) The size of the organism, never constant as regards length, varies in different animals and under different conditions of cultivation, both as regards diameter and length. Absolute statements of size must therefore be received with caution. The fact is now well established for numerous organisms, and appears to be a general law.

(3) The apparent size, as in the case of all cylindrical or spherical bodies, whose substance is of different density at the centre and surface, will appear different in different refracting media, partly owing to the difficulty in focussing the widest part. This is also true when the body is stained, partly because the staining is unequal. Hence cylindrical bacilli, with spores of nearly equal diameter at the end, have been represented as pin-shaped.

(4) The action of reagents or of heat, both in preserving and hardening tissues or fluids, or in staining and mounting processes, has a marked effect upon the apparent size of the organisms. Many of them are proportionately less affected than softer tissue-elements, but the effect is pronounced in nearly all to which special study has been directed. Reagents may also obscure peculiar characters—for example, the *Umhüllung*, or material which forms a sort of shell or capsule around some organisms, and which is derived from a softening of the cell-wall.

And, lastly, it is found that for the recognition of some pathogenic microbes, it is almost essential that the tissues should either be fresh, or that they should be very carefully preserved by special methods. Otherwise, success is exceptional, and the number found very small compared with those actually present.

Cultivation.—Fortunately, in the case of a large number of micro-organisms we have a far more perfect and easy mode of study, that of cultivation or pure culture (*Reincultur*). By this method, introduced by Klebs, and perfected by Koch and others, organisms are not only isolated, sown in fresh soil in successive generations, and thus removed from all addition and impurity, but they can be studied in a pure condition as to their morphological, physiological, and chemical characters. By growth in different media, their fermentative effects and products can be investigated. This at present constitutes one of the most important and hopeful branches of bacteriological research.

By culture, especially when aided by microscopic study, the recognition of various forms becomes easy. For each organism possesses its own peculiar characters, especially when grown upon or in semi-solid media. These characters comprise form of the mass, colour, rate of growth, results and effects on the nutrient media, effects of the presence or absence of oxygen, capacity of growth on different media and temperature. They may vary for the same organism in different media, and when taken together constitute almost absolute distinctions of the various known forms. By the aid of a lens, the earliest groups and colonies may be studied, and will often be found to branch and grow in a characteristic way.

Mode of Cultivation.—Of this a very brief outline must suffice, as the practical details would occupy too much space.

The soil may be: (1) Fluid, as milk, aqueous humour, broths of various kinds, hay and other vegetable infusions, urine, or chemical combinations, such as Cohn's fluid; (2) Semi-solid, as boiled potato, bread paste, &c.; or (3) A jelly, as various broths gelatinised with

isinglass, gelatine, or agar, or serum inspissated by heat. The introduction of gelatinised media by Koch has been an enormous aid to the study of bacteria. All these media may be used with advantage in various cases; but of most universal application, owing to their translucency, ready manipulation, and wide range of utility, are the gelatinised media. They may be used in mass, or spread out in a thin layer on a glass plate or slide, or lining the interior of a test-tube or flask.

The basis of the soil commonly consists of meat broth (fowl, beef, veal, &c.), to which is added a certain quantity of prepared peptone, and in some cases cane or grape sugar. A sufficient proportion of gelatine is added to produce a jelly at normal temperatures. Or if agar-agar is used, the jelly melts at a much higher temperature. The addition of 5 to 8 per cent. of glycerine to the agar jelly appears greatly to increase its activity and range of use, and retards drying up of the jelly ('glycerine agar'). Mixture of serum with jelly may also be employed.

Sterilisation, both of the vessels and cultivating media, is essential; and the absolute exclusion of all external organisms. The former is mainly effected by heat, the latter either by sterilised cotton-wool or by the action of gravity.

The sowing of the microbes in the cultivating soil is effected in the case of solid or gelatinised media by a sterilised platinum wire or glass rod, the vessel where possible being inverted: in the case of fluid media by the same, or by various ingeniously devised forms of apparatus. Practical experience shows that, with ordinary care and some practice, an organism may be absolutely isolated and cultivated through scores of generations with little risk of failure.

Isolation of Micro-organisms.—It is evident from the above that when a micro-organism is present in a fluid or in the tissues in a pure state, its cultivation is generally a matter of little difficulty. All that is necessary is to transfer to the culture-medium in a test-tube a small quantity of the material containing the micro-organism, by means of the sterilised platinum needle. If the medium is solid, the inoculation is made either in the form of a 'stroke' on the surface, or a 'puncture' into the substance of the medium. When several varieties of organisms are present together, various methods have been devised for separating them; and of these the 'plate-cultivation' method, introduced by Koch, is the most useful and most commonly used. The principle of the method is that single organisms in suitable conditions give rise to single colonies of the same organism; and that accordingly, if the colonies are sufficiently separate from one another, pure cultivations can be made from each.

To accomplish this, three or four test-tubes containing peptone-gelatine are taken, and their contents are thoroughly liquefied at about 38° C. One is then inoculated by a platinum needle with a drop of fluid containing the organisms, and its contents are thoroughly shaken so as to distribute the organisms uniformly. Two or three drops of the mixture are then transferred to a second tube, which is also thoroughly shaken. A third is inoculated from the second, and sometimes also a fourth from the third, in the same manner. The contents of the tubes are then poured out in succession on sterilised flat glass-plates or shallow glass-capsules, and allowed to solidify. The plates are then placed in a sterile moist chamber, and allowed to remain till signs of growth appear. In the first, and probably in the second plate, the number of colonies arising from single organisms will generally be too great to allow a satisfactory separation; but in the third, a small number of scattered colonies may appear, and separate test-tubes may be inoculated from any of them by means of a fine platinum needle. The colonies of different bacteria in plate-cultivations present different appearances, according to the colour and form of the colony, the characters of its margins and surface, the position in the medium, and its liquefying the medium or not. This method, therefore, affords a valuable aid in distinguishing different species.

In the case of organisms which do not grow at ordinary temperatures, gelatine plates are not suitable, and agar must be used, or a mixture of agar and gelatine, &c. The agar requires a high temperature to liquefy it (generally about 90° C.), but it remains in the fluid condition down to 40° C., at which temperature it is used.

Instead of using plates, Esmarch rolls the tubes containing the liquid gelatine under a stream of cold water, so that the gelatine forms a thin solid layer lining the tubes. The growth of the colonies in the gelatine layer can then be very conveniently watched.

Modes of Staining Bacteria.—In staining bacteria we employ almost exclusively the basic aniline dyes, which are found to stain all known bacteria with greater or less readiness (though for such as tubercle bacilli special combinations must be used); and of these, methyl blue, fuchsin, methyl and gentian violet are the most suitable. In examining cultures microscopically, a small portion of the culture may be broken down and mixed with a few drops of a weak watery solution of one of these colours; a cover-glass is then placed over the fluid, and the examination made. In order to observe the movements of the organisms, it is better to examine them first simply in distilled water, and they may be coloured afterwards by placing a drop of the staining solution at the edge of the cover-glass, and allowing it to mix with the water. Permanent preparations of

pure cultures are best made by spreading a small quantity of the culture on a cover-glass (if the culture is solid a small quantity ought first to be mixed with a sterile fluid), allowing it to dry, and then passing it two or three times through a gas-flame. The film may then be stained by floating the cover-glass on a weak watery or alcoholic solution of one of the above-mentioned stains; or some of the special staining methods may be used, and for certain bacilli this is necessary. Fluids containing bacteria, the juice of tissues, &c., may be examined in a similar manner.

In staining bacteria in sections of tissues, in fluids rich in cells, &c., the tissue-elements are apt to become stained in such a way as to obscure the organisms, and accordingly various methods have been devised in order to remove the stain wholly or partially from the tissues, and leave the bacteria coloured. The principle of all these methods is the same, namely, the employment of chemical agents along with the stain, which aid its penetrating power, and tend to fix it in the bacteria—mordants, for example, aniline oil, carbolic acid, tannin, and various metallic salts; and the subsequent treatment with decolorising agents, such as weak alcohol, acetic acid, and mineral acids, in order to remove the excess of stain. The combinations of stain, mordant, and decoloriser are very numerous; of the mordants, aniline oil and carbolic acid are the most commonly used. One of the most useful combinations is gentian violet with aniline oil, made as follows: A watery solution of aniline oil is made by shaking about 5 parts of aniline oil in 100 of water; this is filtered, and there is then added to it 5 to 10 parts of a saturated alcoholic solution of gentian violet; the mixture is then carefully filtered. Sections are stained in this for a few minutes or longer (according to the properties of the bacteria), and then decolorised by a weak solution of acetic acid to the required extent. Another well-known solution is Ziehl's carbol-fuchsin solution, whose composition is: Carbolic acid, 5 per cent. in water, 100 parts; alcohol, 10; fuchsin, 1. Kühne's carbolic methyl-blue solution is made in the same way, methyl blue being used, in somewhat larger proportions, instead of the fuchsin. The sections may be afterwards decolorised in acetic acid or alcohol. We have found this a most useful stain for general use. Alkalis as a rule increase the staining power of the aniline dyes, and accordingly we have various combinations of methyl blue or violet with carbonate of ammonium, potash, &c. An excellent formula is that of Löffler—30 cc. of a concentrated alcoholic solution of methyl blue, added to 100 cc. of a weak solution of caustic potash, 1 : 10,000. Sections are stained for varying lengths of time, generally about half an hour, and then decolorised by weak acetic acid.

By these various methods the nuclei of the tissues also retain their colour to a greater or less extent; and a method has been devised by Gram by means of which a staining of the bacteria alone is obtained. In this method the iodine forms with the gentian violet a combination within the micro-organisms which remains after the nuclei have lost their colour. Sections, &c., are first stained in the gentian violet aniline-water solution, are washed in water, and are then placed for about two minutes in the iodine solution (iodine 1, iodide of potassium 2, water 300). They are then washed repeatedly in alcohol till the colour is almost completely discharged, and the tissues can then be counterstained by eosin, picro-carmine, &c. Günther has modified the method by placing the sections in weak hydrochloric acid (3–5 per cent.) for ten seconds after they have been half a minute in alcohol, and thus removes a precipitate of the stain which is sometimes liable to form. Gram's method, though excellent for many purposes, is not universally applicable, as it is found that many bacteria lose the colour along with the tissues during the washing with alcohol; and accordingly, in the description of the various species of bacteria, one of the points generally stated is whether or not they become decolorised in Gram's method, though many of the statements made are too absolute.

In order to obviate the decolorisation which occurs in the case of some bacteria during the process of dehydration with alcohol, various means have been employed, one of the best of which is that of Weigert. In this method the sections, after being stained in an alkaline gentian violet solution, are dehydrated with pure aniline oil, cleared in xylol and mounted in balsam. One of us has also found that sections of tissues embedded in paraffin can be stained in a very simple manner. The sections, which ought to be as thin as possible, are floated on the surface of a weak solution of the aniline stain, and the liquid is very gently heated. The sections become quite flat, and the stain is seen to penetrate into the tissue. After a few minutes they are washed well on the surface of water, placed on a slide, and allowed to dry. The paraffin is then removed by xylol and the section is mounted in balsam. By this method bacilli which are decolorised with the greatest readiness with alcohol remain deeply coloured, whilst the strength of the stain and the time of staining can easily be regulated so that the tissues are not over-stained.

Tubercle bacilli afford an example of micro-organisms which do not readily take up the stain, but they retain it with great tenacity. Various methods have been devised, the best being probably the Ziehl-Neelsen method. Films of sputum, &c., are stained

with the carbol-fuchsin solution, and heated till steam arises, for three or four minutes. They are then decolorised in dilute sulphuric acid (20 per cent.), till the colour is almost gone, then they are placed in water. The acid is then thoroughly removed by washing in water, and they may be counterstained by placing them in a watery solution of methyl blue for one or two minutes. The tubercle bacilli are thus stained bright red; the tissues and other bacteria are stained blue. The heating facilitates the penetration of the stain and accelerates the process; but it is better to stain sections for a longer time in the cold (seven to eight hours), as they are apt to become crumpled by the heating. The process of staining can be still further shortened by combining the processes of decolorising and counterstaining by means of the following solution: Water 50 parts, alcohol 30, nitric acid 20, methyl blue to saturation. Sections, &c., after being stained in the carbol-fuchsin solution, are placed in this for about a minute, and are then washed in water, &c. (B. Fraenkel). Further details will be given in the description of special organisms.

Staining of spores.—In ordinary staining with gentian violet, &c., the spores of bacilli do not generally take up the stain, but appear as bright uncoloured points. By using the carbol-fuchsin solution, however, with the assistance of heat, they can be coloured, and if a strong decolorising agent be then used it is found that the cells lose their colour whilst the spores retain it. A contrast stain such as methyl blue may then be used. This method succeeds well in the case of some bacilli (*B. subtilis*), but not of all; and as it is somewhat uncertain in its results it cannot be always relied upon as a test for demonstrating spores.

Staining of flagella.—Löffler's method for demonstrating flagella consists of two stages—first, treatment with a mordant; secondly, the application of the staining solution. The mordant has the following composition: 10 cc. of a 20 per cent. solution of tannic acid, a few drops of a saturated solution of ferrous sulphate, and 4 to 5 cc. of logwood infusion (logwood chips 1, water 8). A few drops of this are placed on the cover-glass preparation, and the fluid is heated for a minute or two till steam arises. The cover-glass is then washed in water; and we have found that a very prolonged washing is necessary for a successful result. The preparation is then stained, Löffler's special stain having the composition—Saturated watery solution of aniline oil 100, solution of caustic soda (1 per cent.) 1, gentian violet in powder 4; the mixture being thoroughly filtered.

Relations of Micro-organisms to the Living Body.—It may now be accepted as an established fact that the healthy tissues and fluids within the substance of the body are free from microbes. But the surfaces, both external and internal, constantly teem with them in the most varied forms. Doubtless a large proportion of these are of innocuous character, in however large quantity they might enter the blood; although by artificial cultivation some of these forms can be produced in sufficient quantity to be toxic if injected. And since some pathogenic forms, which are common, must frequently come into contact with the various mucous surfaces and the skin, we cannot exclude them from consideration.

The mechanism, so to speak, by which this bacterium-free condition is maintained during healthy life has been the subject of much experiment and controversy. Since foreign particles of various kinds, much larger than microbes, can and do enter the lymphatics (and blood-vessels) of the air-passages, alimentary canal, and even the skin, it is certain that microbes can also enter. Experiment has shown that even if large quantities of certain cultivations are injected subcutaneously or into the blood-stream, they rapidly disappear, and in some cases after a few hours they can hardly be detected in the blood, or even in the lungs, spleen, and kidneys, where they appear to be largely arrested. Those discovered are often in various stages of degeneration or decay, and sometimes many are contained in leucocytes and connective-tissue corpuscles.

According to some, it is especially by the activity of leucocytes and connective-tissue corpuscles that micro-organisms are destroyed. Of late years this view has been especially developed by Metchnikoff and his followers, who have alleged for some leucocytes the special *rôle* of *phagocytes*, ingesting, amœba-like, noxious foreign particles, and having as one of their highest functions the elimination of microbes. That such a part is played by leucocytes and by connective-tissue and by other cells which have considerable amœboid activity (epithelia of pulmonary alveoli and of peritoneum), has long been admitted; and this not merely for the absorption of living organisms, but also for other particles, such as molecules of decayed protoplasm, effete hæmocytes, pigment particles, &c. But whilst they react in a similar manner in relation to microbes, the latter may continue active and germinate in the leucocytes, and may in some cases cause their destruction.

That the freedom from organisms is not solely due to the leucocytes is shown by the fact that blood-serum and other materials, which are free from leucocytes, also exert a destructive influence upon microbes. The freedom from bacteria may therefore be regarded as due in part to the fact that the healthy fluids and tissues of the *living* body

exert an antagonistic action to, or do not serve as a suitable soil for, the growth of bacteria. The chemical or physical nature of the antagonistic condition is a highly important question, and one which at present is being closely investigated. That the antagonistic condition may be a very minute chemical change is suggested by the facts of immunity, natural or acquired, and by modified susceptibility under variations of nutriment.

The power of resistance to inoculation or infection may be extremely slight for some kinds of microbes; where it is considerable, it may be insufficient to resist a large dose of the virus. Direct experiment has shown that by great increase of the number of the organisms introduced, or by repeated inoculations, pathogenic effects may be produced, even where the power of resistance is great. Resistance to one microbe may be lowered by the previous or concurrent activity of another. The introduction of unorganised ferments into the blood (*e.g.* papayotin) may, it is alleged, so diminish the normal resistance, that the common forms of bacteria readily enter into and multiply in it.

During the last stages of life, and apparently also in some conditions of disease, the power of resistance may be so lowered that common bacteria are found in the blood, and penetrate more deeply into the tissues with which they are normally in contact—*e.g.* in the alimentary system. But it must be remembered that resistance to the entrance of microbes, and resistance to the effects of pathogenic microbes, are two entirely different orders of facts, and can only be used to explain one another within restricted limits.

Some general statements may here be briefly made as to our present standpoint on the subject of contagion and immunity. These statements are intended only to represent what we have strong evidence for believing, but what as yet is not fully and generally proved.

The pathogenic activity of a microbe in any given case is dependent upon—

1. As regards the virus:—the active vitality of the organism, its stage of development, the nature of the nutrient medium or soil on which it has grown, the quantity of the dose, and the presence in the virus of unorganised ferments or other substances, usually generated by the growth of the microbe, which lower the vitality locally of the tissues, or generally of the body, into which the virus enters. Such substances may in some cases be generated by the concurrent action of other microbes.

2. As regards the individual:—the inherent or acquired capacity of resistance (of unascertained nature), the healthy activity of the leucocytes and other cells, and the normal healthy condition of the fluids of the body. Under this head must be included the absence of any local deterioration or area of malnutrition or necrosis, which can afford a nidus for the development of the microbe within the body.

And, further, in so far as the known facts of contagious or infectious diseases can be accepted as evidence, the presence and activity of one virus may prevent or retard the action of another equally potent, but may tend to render the individual more susceptible at a later period.

Some medicinal substances may also possibly prevent the activity of the virus, but as yet our experimental knowledge is very limited. Thus corrosive sublimate in considerable doses may fortify against anthrax inoculation (Cash). A wide field is here open for future investigation.

And, lastly, the facts of immunity acquired by an attack of some diseases have laid the foundation for protective inoculation by a modified or attenuated virus.

Some of the facts bearing upon the statements here made will be briefly mentioned under the head of various diseases.

Relations of Bacteria to Special Diseases.—In considering the various diseases associated with bacterial infection, we find that in some the evidence that they form the virus is absolute, in others it is incomplete in varying degree, whilst there are some which from their close analogy, and from some partial evidence, may be provisionally included in the list.

In studying individual diseases and their relation to bacteria, we may conveniently group together those which have close analogies either in their clinical and pathological features, or in the characters of the organisms which produce them. Some of these groupings will be fairly accurate from a scientific standpoint, others can be only provisional. The advantage of such grouping lies in the fact that it avoids much repetition, and facilitates the study of allied diseases. But it must not be regarded as anything more than a convenient mode of arrangement with our present knowledge.

Group I.—(1) Suppuration (especially in acute and spreading forms), Pyæmia, and Septicæmia; (2) Osteo-myelitis or Acute Necrosis; (3) Ulcerative Endocarditis; (4) Erysipelas; (5) Gonorrhœa (grouping doubtful); (6) Acute Pneumonia (grouping doubtful).

Group II.—(7) Malignant Œdema; (8) Tetanus.

Group III.—(9) Tubercle; (10) Leprosy; (11) Glanders; (12) Actinomycosis; (13) Rhinoscleroma; (14) Syphilis.

Group IV.—(15) Cholera; (16) Relapsing Fever.

Group V.—(17) Anthrax; (18) Diphtheria; (19) Typhoid; (20) Epidemic Influenza.

Group VI.—Diseases in which, though

alleged by some, there is as yet no sufficient evidence of bacterial origin.

And it seems desirable to append a brief account of the micro-organisms of malarial fevers, although they are not bacterial in nature.

Group I.—*Suppuration, Pyæmia and Septicæmia, and 'Wound-Infection Diseases' in General.*—This group includes those common 'septic' conditions which are frequently the sequel of wounds and allied conditions. They are usually associated either with suppuration or spreading inflammation, and more or less intense blood-poisoning. They are produced by various bacteria, of which some are common, others rarer causes. To some extent the form of disease produced is dependent on the mode of introduction or on special conditions which modify the action of the virus. Thus, the organism of osteomyelitis can produce ulcerative endocarditis, as can also certain other bacteria. What we call erysipelas may be produced by various bacteria, *e.g.* experiments on the lower animals have shown that the bacillus of mouse-septicæmia, a blood-disease in mice, causes local erysipelas in the ear of a rabbit. But in man, experience shows that the commonest causes are few and well defined.

Under this head should also be included the various forms of Infectious Gangrene, such as 'hospital' gangrene, cancrum oris, &c. But our knowledge of these conditions is, as regards man, too incomplete to allow of any definite statements, and we have therefore not discussed it separately.

1. Suppuration, Pyæmia, &c.—To avoid ambiguity, it may be stated that we look upon suppuration as a sequel of inflammation under certain circumstances in which, by gradual accumulation of leucocytes which have passed from the blood-vessels, and gradual liquefaction of the tissue-elements, the part affected becomes occupied by the cream-like fluid known as pus. Such a process, after starting at one point, may spread to a greater or less extent, and sometimes occurs in association with similar lesions in various parts of the body. Suppuration is accordingly to be distinguished from those conditions in which, by the action of a severe irritant, a co-extensive local necrosis of the tissue occurs, which may afterwards undergo some softening. Some of the most important questions in connexion with this subject are: Can suppuration occur apart from the action of micro-organisms? What organisms are generally concerned in the process? And what is the relation of strictly local abscess-formation to those conditions in which so-called metastatic abscesses occur, and which are commonly grouped under the head of *pyæmia*?

Whilst various pyæmic conditions present the characters generally associated with diseases of bacterial origin, the theory that suppuration is in all cases caused by micro-organisms might *à priori* be open to doubt. Partly, however, as the result of early bacteriological investigations, partly as the result of the antiseptic treatment of wounds, the belief gained a wide currency that without bacteria suppuration could not occur. Within recent years, extensive series of experiments have been performed by various workers in order to determine whether suppuration can be produced by a simple chemical substance. The methods of performing these experiments have been various. In some, the substance to be tested was simply injected under the skin with antiseptic precautions, the puncture being closed immediately afterwards; but as this was open to certain objections, the method was devised of placing the chemical substances in sealed glass tubes, which were introduced into the tissues, and were broken after the external wound had healed. In others, again, the tubes had sharp ends, so that after a time they could be moved under the skin to another part of the body and there broken. Though it has been clearly proved by such experiments that in most cases suppuration does not follow, and that its occurrence is not dependent upon the intensity of the irritant, yet many observers (Councilman, Grawitz and De Bary, Steinhaus, Christmas, and others) agree in finding that certain chemical substances (*e.g.* nitrate of silver, mercury, &c.) can produce local abscesses, whose contents can be shown by inoculation on culture-media to be free from the ordinary pyogenic organisms. Amongst the substances found to be capable of producing suppuration in this way are the chemical products of several of the pyogenic bacteria.

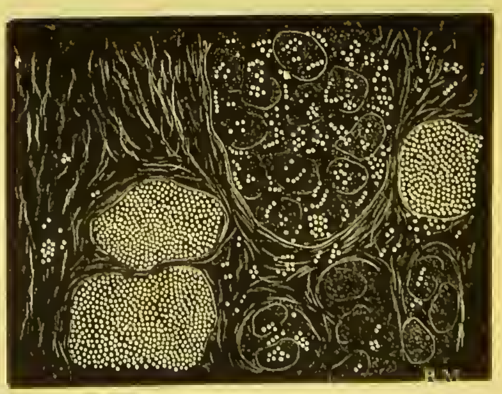

Fig. 75.—Masses of Micrococci (Staphylococci probably) in the vessels in 'surgical' kidney.

But even if it be admitted that pus, with all its essential characters, can be produced by the action of a simple chemical agent, much more important questions must be

answered, namely, What are the actual causes of suppuration as met with clinically? What organisms are present? and Have they pyogenic properties?

Amongst the first to demonstrate the presence of bacteria in ordinary suppuration was Ogston of Aberdeen, who, in a paper published in 1881 (*Brit. Med. Journ.* 1881, i. p. 369), described the practically invariable presence of micrococci in acute abscesses, and affirmed them to be the causal agents in the process. Some of these organisms, from their growing

FIG. 76.—Streptococci in Fœtid Sputum. × 800 diam.

in the form of clusters, he called *Staphylococci*; to others which grew in the form of chains he applied the name *Streptococci* (previously given by Billroth). The former he found to be specially associated with circumscribed abscesses; the latter with spread-

FIG. 77.—Streptococci of Suppuration.—Dried pus from an empyema of some duration. Showing chains of streptococci, some of which are swollen, probably from degenerative changes. × 800 diam.

ing erysipelatoid suppurations—facts which have since been confirmed ('Micrococcus-Poisoning,' *Journ. Anat. and Phys.* 1882-3). Shortly afterwards Rosenbach (*Mikroorganismen bei den Wund-Infectionskrankheiten des Menschen*, 1884), by means of solid culture-media, obtained pure growths of these organisms, and separated several distinct species. The three most important of these he called *Staphylococcus pyogenes aureus*, *Staphylococcus pyogenes albus*, *Streptococcus pyogenes*; whilst another, less frequently met with, he called *Micrococcus pyogenes tenuis*. Other organisms have been found in acute abscesses, *e.g.* *Staphylococcus pyogenes citreus*, *Staphylococcus cereus albus*. *Staphylococcus cereus flavus*, *Bacillus pyogenes fœtidus* (Passet, *Fortschr. d. Med.* 1885, Nos. 2 and 3), *Bacillus pyocyaneus*, &c.

Staphylococcus pyogenes aureus.—The most frequently present of these organisms, and that which has been the subject of most investigation, is the *Staphylococcus pyogenes aureus* (yellow cluster-coccus, *Gelbtraubencoccus*). This organism, when grown on culture-media, has certain characteristics which render its recognition comparatively easy. In puncture-cultivations on gelatine, growth is seen first (in about twenty-four hours at the ordinary temperature) as a greyish-white line along the needle-track. The growth soon assumes a yellowish colour, and, as liquefac-

FIG. 78.—Multiple Suppurative Septic Nephritis ('Surgical Kidney').—Shows short bacilli in capillaries and in cells. × 800 diam.

tion of the gelatine rapidly occurs around it, forms a flocculent mass at the junction of the fluid and solid portions, being afterwards of bright orange colour. If a stroke-cultivation be made on agar a similar growth takes place along the line, which soon shows a bright orange colour; and as its surface is smooth and shining, its appearance has been aptly compared to a streak of orange oil-paint on the surface of the medium, which does not undergo any liquefaction. It also grows on potatoes, producing here also the characteristic yellow colour. Its growth on these media after a few days has a peculiar sour smell. On gelatine-plates it grows as minute round points, which soon reach the surface, and then liquefaction occurs around them, so that small masses of growth are seen lying in small cups, the centres of growth having by this time acquired a yellowish colour. In

its growth on gelatine a considerable amount of peptone is produced—a fact which has been employed to explain some of the phenomena of suppuration. It renders the medium acid, and hence causes coagulation of milk, in which it readily grows. It is capably anaërobic, but when it is grown in the dark and in the absence of oxygen the yellow colour is not produced. As has been already mentioned, it stands a higher temperature than most bacteria, and has great tenacity of life, fresh cultivations being sometimes readily made from cultures more than a year old. Microscopically, the growth is found to consist of spherical cocci about ·9 μ in diameter, which are seen growing in the form of large masses or clusters.

Staphylococcus pyogenes albus. — The *Staphylococcus pyogenes albus* has similar characters to the preceding, with this exception, that its growth never assumes a yellow colour, but is always white. The two species, however, are quite distinct from one another, and all attempts to permanently deprive the aureus of its power of producing the yellow pigment have failed.

Streptococcus pyogenes. — The *Streptococcus pyogenes* grows more slowly than the two organisms just described, and differs from them also in that it never causes liquefaction of the gelatine. In gelatine puncture-cultivations a faint line first appears, which may be seen by means of a lens to consist of numerous minute points, of a whitish translucent appearance. These gradually enlarge and appear as round discrete centres, which rarely exceed a pin's head in size, though fresh centres may form around them. On the surface of agar, growth takes place in a similar manner on either side of the stroke, giving a characteristic fernleaf-like appearance. Little or no growth occurs on potatoes. Microscopically, the growth is seen to consist of spherical cocci a little larger than the staphylococci described, generally growing in the form of chains, which may contain many cells, also occurring singly and in pairs. The same characteristic arrangement is seen when the organism is growing in the tissues.

All these three organisms stain readily with Gram's method.

Coming now to consider the association of these organisms with acute suppurative conditions, we find a wonderful agreement in the observations of a great many independent workers. The original statement of Ogston, that in all acute abscesses the presence of micrococci can be demonstrated, has been proved by subsequent extensive researches to be a law to which there are few, if any, exceptions. The researches of Rosenbach, Passet, Garré, Krause, Watson Cheyne, and many others may be mentioned in this relation. Sometimes only one kind of bacterium is found, sometimes two or more together, the most frequently present being the three micrococci above described; and of these the Staphylococcus pyogenes aureus is perhaps the commonest. These organisms have been found in the utmost variety of suppurative conditions—whitlows, boils, subcutaneous abscess, diffuse phlegmon, empyema, &c. In some chronic abscesses, as Ogston stated, it may be impossible to detect their presence.

Are these organisms, then, the cause of the suppurations with which they are associated? In considering the experimental side of the question we may take the *Staphylococcus pyogenes aureus*, as it has been the organism most commonly employed. At the outset it may be stated that its power of producing suppuration depends upon the number of micrococci injected; and that number varies not only for different animals, but for different parts of the same animal, for example, suppuration is much more easily produced in the anterior chamber of the eye than in the peritoneum. When introduced into the subcutaneous tissue (most conveniently as an emulsion in neutral salt solution) it produces a local abscess with typical characters. Shortly after being injected, the cocci multiply in the connective-tissue spaces, and are found not only lying free, but also within the leucocytes, connective corpuscles, and the endothelium of capillaries. Inflammatory action rapidly supervenes, and leucocytes pass in great numbers into the tissues from the capillaries, the emigration progressing till the tissue appears quite filled with leucocytes of the multinucleated type, in many of which micrococci may be seen. At the margin of the affected area cocci are still found lying free in the lymphatic spaces. As the aggregation of leucocytes becomes more and more marked, the connective-tissue elements undergo softening and liquefaction, the ultimate result being that the part affected becomes occupied by typical pus. The spread or arrest of the suppuration depends upon the growth of the micro-organisms. In favourable cases this ceases after a time, and the process of repair sets in.

The liquefaction of the tissue-elements, and the non-coagulability of the inflammatory exudation, have been ascribed to the peptonising power of the organism; and the vascular phenomena, in part, to the actual invasion of the capillary walls by the organism, though chiefly to the action of its chemical products. According to late observers (*e.g.* Steinhaus, Christmas) the sterilised cultures of Staphylococcus pyogenes aureus have also the power of producing suppuration, and Brieger has isolated a toxalbumin which he finds to have the power of producing suppurative liquefaction of the tissues.

It may also be mentioned that experiments with this organism have been made

on the human subject. Garré (*Fortschr. d. Med.* 1885, No. 6) inoculated Staphylococcus pyogenes aureus on a few small scratches near the root of the finger-nail, and produced a small cutaneous abscess; and by rubbing a cultivation on agar into his arm he caused a carbuncular condition, which only healed after some weeks. Bockhart and Bumm have confirmed the observations of Garré.

Staphylococcus pyogenes albus has the same pyogenic properties, but many observers have found that it is less virulent in its action. *Streptococcus pyogenes* in its growth in the tissues has rather a tendency to spread by the lymphatics over a wide surface, than to form a local abscess. It causes suppuration when injected into the serous cavities and joints, and clinically is often met with in those positions when suppuration is present. Several other organisms have been proved to possess pyogenic properties.

Injection of Staphylococcus pyogenes aureus into the blood produces effects according to the dose: if the amount be small no result may follow, if very large the animal dies with septicæmic symptoms within a few hours. If the animal survive a large injection for more than a day, changes often occur which form a type of what is seen in various pyæmic conditions in the human subject. For a time after the injection the organisms can be found in the blood, but they gradually disappear from it, and are found in the capillary walls, kidneys, liver, &c. According to Lübbert (*Der Staphylokokkus pyogenes aureus, &c.* 1886) and Krause (*Fortschr. d. Med.* 1884, Nos. 7 and 8), they also pass into the urine, and can be cultivated from it; but this probably occurs only after the organisms have actually grown into the tubules, and cannot be regarded as a true excretion, as some have supposed. Of the changes found after twenty-four hours, the most constant are those in the kidneys. Under the capsule are seen a number of paler points, surrounded by a zone of intense injection, and corresponding to those there are found on section numerous areas of pyramidal or oblong shape in the cortex, while in the medulla pale streaks or lines of pale dots are seen running between the tubules. Microscopically, many of the small arteries and capillaries in these areas are seen to be plugged with collections of micrococci, whilst these are also found in the lining of other vessels, both arteries and veins. In the tissue surrounding these vessels micrococci may be found, and the cells of the tubules show necrotic change, while at the margin infiltration of leucocytes is seen. Later the affected areas undergo purulent infiltration and softening, and form small abscesses. Quite analogous changes are found in other parts of the body, though less constantly than in the kidneys. In the muscle of the heart small vessels may be plugged in the same way, the fibres around being the seat of necrotic change with infiltration of leucocytes, leading ultimately to foci of acute suppurative myocarditis. Abscesses are also occasionally produced in the ordinary striped muscles, in the joints, under the periosteum, and in the medullary cavities of bones.

FIG. 79.—Micrococci in capillaries of kidney in Multiple Septic Abscess. Showing masses of cocci like Staphylococcus pyogenes aureus.

Similar phenomena are sometimes observed in the human subject in cases of ulcerative endocarditis and osteo-myelitis; and though ordinary pyæmia presents some differences, these are to be explained by its method of production. In pyæmia the series of events generally starts with a septic phlebitis caused by an external wound, and associated with the formation of a thrombus which afterwards softens and becomes the source of emboli. The softening of the thrombus is for the most part due to pyogenic organisms, though others may be associated with them; and as the portions of softened thrombus are in the course of the circulation carried first to the lungs, and there plug the pulmonary vessels, pulmonary abscess is an almost constant feature in the common form of pyæmia. In experimental intravenous injections of staphylococci, on the other hand, points of suppuration are very rarely found in the lung, as the organism seems unable of itself to gain a foothold and flourish in the lung-tissue. Various organisms have been cultivated from pyæmic abscesses and from the blood in pyæmia, but by several observers a streptococcus has been found to be most frequently present, and Rosenbach considered it the chief organism concerned, though not regarded as specific. The rare occurrence of 'metastatic' phenomena in the course of ordinary suppuration is probably to be explained by the fact that, even if a few organisms do enter the blood, their growth is arrested by the bactericidal power of the serum and leucocytes, as is shown by direct experiment. If, however, there be a weak

locality to which they are carried by the circulation, they may there undergo development, and from that point as a focus secondary infection may occur.

We may therefore conclude that practically all cases of acute abscess-formation occurring under natural conditions, as observed clinically, are due to the growth of bacteria; that there is not one specific organism of suppuration; but that several organisms have pyogenic properties, though the three species of micrococci above described are those most commonly present. The results vary according to a great many conditions, and especially as to whether or not the organism obtains a foothold in the blood. The actual virulence of the bacteria has also been found to vary under different conditions, as is the case in so many diseases.

2. **Osteo-myelitis and Acute Suppurative Periostitis (Acute Necrosis).**—In 1883 Becker (*Deutsch. med. Woch.* 1883, No. 46) cultivated a micrococcus from the pus in cases of osteo-myelitis, which he considered to be peculiar to the disease. Shortly afterwards Krause confirmed his observations as regards its presence and characters, but after careful observations and experiments found it to be identical with the Staphylococcus pyogenes aureus. His conclusions have been confirmed by Rosenbach, Passet, and many others; and there is now little doubt of the identity of the two organisms. The micrococci from osteo-myelitis have been injected subcutaneously and have produced local abscesses; and, on the other hand, staphylococci from abscesses, &c., when injected into the circulation produce the same results as those from osteo-myelitis. As regards the presence of organisms in osteo-myelitis, it may be stated from a comparison of the results of many different observers that Staphylococcus pyogenes aureus is the organism most commonly present, less frequently Staphylococcus pyogenes albus and Streptococcus pyogenes; here, too, as in ordinary abscesses, more than one kind of organism may be present. Some cases are also recorded of osteo-myelitis due to the pneumonococcus (Fraenkel's), and in one or two other cases other organisms have been found. The invariable presence of bacteria in the disease is a well-established fact.

It has already been mentioned that foci of suppuration in the bones sometimes occur as a result of the intravenous injection of Staphylococcus aureus, but on this point various observers have obtained different results. Some have failed to find the lesions (Lübbert), whilst others have found them frequently, and some have produced a large abscess when the bone was broken or crushed before the injection. The small abscesses are found under the periosteum, in the substance of the bone, and in the medullary cavity. It has also been found that young animals are especially liable to become affected in the bones (Colzi). Lannelongue and Achard (*Ann. de l'Instit. Past.* April 1891) found these abscesses frequently in their experiments, not only when Staphylococcus aureus was used, but also when Staphylococcus albus and Streptococcus pyogenes were injected. They found Staphylococcus albus to be less virulent than Staphylococcus aureus, and they found certain peculiarities in the case of Streptococcus which accorded with some features of osteo-myelitis due to this organism which they had investigated clinically. The foci of suppuration in these experiments are generally of smaller size than in the human subject, but otherwise closely correspond in their characters. We must also bear in mind that the condition in clinical cases and in experiments are not exactly the same, for in the latter a large number of organisms are introduced suddenly into the blood, some of which settle in the bones—in the former probably a small number at first take root in a specially susceptible nidus.

We must therefore consider it proved that the cause of acute suppurative periostitis, and allied conditions, is the growth of certain pyogenic organisms (especially the Staphylococcus pyogenes aureus) under the periosteum of bones, in the marrow, &c., under conditions specially favourable for their development. It may also be noted that in the course of this disease secondary lesions are sometimes met with in the kidneys and other organs, which are quite similar to those produced by the intravenous injection of Staphylococci.

3. **Ulcerative Endocarditis.** — This condition has for a considerable time been believed to be due to micro-organisms, and the microscopic examination of a great many cases has revealed their presence, chiefly in the form of micrococci, in the diseased valves. These organisms are sometimes present in enormous numbers, and by their growth cause a necrotic change in the tissue-elements, which is followed by ulceration, and by embolism in various organs. Cultivation-experiments have shown the organisms present to be chiefly pyogenic organisms of various kinds, the most common being Staphylococcus pyogenes aureus and Streptococcus pyogenes. These cultivations have been made by many independent observers, and considerable harmony prevails amongst their results.

It has been observed that in some cases of the disease the ulcerative condition has supervened on a simple endocarditis, especially of the vegetative form, whilst in others it is apparently primary. The former condition has been experimentally imitated by Orth and Wyssokowitz (*Centralb. f. d. Med.*

Wis. 1885, No. 33), who injured the aortic valves by a rod introduced through the right carotid artery, and afterwards injected staphylococci into the blood. The micrococci were by this means enabled to gain a foothold at the injured spot, and ulcerative endocarditis followed. Ribbert (*Fortschr. d. Med.* 1886, No. 1), however, afterwards found that by introducing certain quantities of an emulsion of a potato-culture of Staphylococcus pyogenes aureus (there being in the injected fluid small fragments of potato containing micrococci), an endocarditis could be set up on the mitral and also on the tricuspid valves, without any previous injury to these valves. In some cases the small fragments appear to have become arrested at the attachment of the chordæ tendineæ, and thus the organisms were brought into closer and longer contact with the endothelial surface. They formed at first a layer on the surface of the endothelium, but afterwards grew into the substance of the valves, whilst thrombi formed over them. In the course of ordinary intravenous injections of Staphylococcus aureus, Lübbert found that endocarditis was produced in one case only.

In some cases of ulcerative endocarditis occurring in the course of or following croupous pneumonia, Fraenkel's pneumonococcus has been found to be the organism present; and Netter (*Archiv. de Phys.* 1886, p. 106), after cultivating this organism from the ulcerated valves, produced endocarditis experimentally by a similar method to that employed by Wyssokowitz. He found, however, that not all the cases of ulcerative endocarditis associated with pneumonia were due to pneumonococci, for in some streptococci alone were present. In other cases still, bacilli of different kinds have been found in the diseased valves—one of which was traced by Martha and Netter to an abscess in the liver, in which the same organism was present.

It may therefore be stated that a variety of organisms may cause the ulcerative lesion on the heart-valves, especially if they have been the site of previous disease, but that staphylococci and streptococci are most frequently the causal agents.

4. **Erysipelas.**—A spreading inflammatory condition of the skin, attended with redness, can be produced by a great many causes, and especially by several varieties of micro-organisms—for example, an erysipelatous condition is sometimes produced by the bacillus of anthrax. Nevertheless, cutaneous erysipelas as met with in the human subject is a fairly typical disease; and it is to this disease, or rather perhaps to its most common variety, that the following statements apply.

Erysipelas, besides presenting some peculiar problems, is also of interest because its contagium was at a comparatively early period proved to be of bacterial nature, by experiments actually performed on the human subject. Though the presence of organisms in the lymphatics of the affected area in erysipelas had been observed before (first by Lukomsky and v. Recklinghausen), Fehleisen (*Die Aetiologie des Erysipels*, Berlin, 1883) was the first to isolate and cultivate an organism which he found capable of producing the disease, and which he affirmed to possess distinctive characters. This organism he called *Streptococcus erysipelatis.* Its characters, however, closely resemble those of the Streptococcus pyogenes, and there has been much discussion as to whether the two organisms are the same. The differences in the manner of growth of the two organisms on culture-media, at first stated to exist, have since been found by most observers to be insufficient to distinguish them, and inoculation-experiments on animals have given practically similar results. Passet found by inoculating the ear of a rabbit that an erysipelatous condition was produced by both organisms, but that the action of Streptococcus pyogenes was rather more severe—whilst other observers have failed to find any difference in their mode of action in animals. It has also been stated that the Streptococcus erysipelatis is capable of producing suppuration. It is accordingly the opinion of many authorities that the same organism is concerned in the production of both conditions, and that it depends upon the point at which the organism settles and multiplies after inoculation, and on other conditions, whether erysipelas or a spreading cutaneous suppuration is produced. The question cannot be fully discussed here, but this explanation seems scarcely in accord with clinical facts, for erysipelas once started has the tendency to spread from case to case as erysipelas, and its whole course is that of a disease due to a special organism brought from without. It therefore appears possible that, though they cannot be distinguished by their manner of growth, there are really two or more distinct species, one of which commonly produces erysipelas in the human subject. Indeed there are many facts which make it likely that there are several species of streptococci very similar in their method of growth, but which play different parts in the pathological processes, as in diphtheria.

Fehleisen had observed that several patients suffering from malignant tumours showed signs of improvement after having become affected with erysipelas, and accordingly considered it justifiable to produce erysipelas as a therapeutic measure. The results of these experiments as regards their effects upon tumour-growth need not concern us here; but in a series of cases he was able to produce erysipelas with all its accompanying features by inoculation into scratches on

the skin of pure cultivations of the Streptococcus erysipelatis, some of these being cultivated through many generations. A similar condition was also produced in rabbits, but many other animals appear not to be susceptible to the disease.

In erysipelas the micrococci grow in the lymphatic system of the cutis, and produce an inflammatory condition attended with exudation, indicated clinically by the well-known area of spreading redness with slightly raised margin. The micrococci are found in great numbers, growing in chains and singly, in the lymphatic spaces immediately beyond the swollen edge, often plugging the lymphatic channels. They are also found within the cellular elements of the part. As they spread by their growth they produce the usual phenomena of inflammation, attended with a considerable amount of exudation, which may coagulate. The tissue-elements undergo some swelling and may show some degenerative change, but no actual softening or liquefaction occurs as in suppuration. The micrococci rapidly break down and disappear after the inflammatory condition has been established, whilst they continue to multiply in the lymphatic spaces beyond the inflammatory margin. After a time their growth generally comes to an end, but the means by which this takes place cannot be discussed here. The growth of the organisms is practically confined to the lymphatic system, and although probably a few do enter the blood-stream, they do not appear to be able to multiply there, and cultivation-experiments both in clinical cases and in artificial inoculations have almost invariably failed to show their presence in the blood. The general symptoms, often of severe character, attending the progress of erysipelas, are most probably due to absorption of the products of the growth of the organisms in the tissues; and Manfredi and Traversa have found that the products of the growth of the erysipelas micrococcus when injected into animals cause grave nervous phenomena, partly of convulsive, partly of paralytic nature.

Fehleisen found that a patient who had suffered from erysipelas a short time before was insusceptible to fresh inoculation, and the same has been observed in the case of animals. This immunity, however, he found only to be of short duration, and this accords with the fact that erysipelas in the human subject may show a tendency to recur.

5. **Gonorrhœa**.—The first account of an organism peculiar to this disease is that of Neisser, who in 1879 (*Centralb. f. d. med. Wis.* No. 28) described a micrococcus, whose morphological characters and relations to the pus-corpuscles in the secretion served, he considered, to distinguish it from other organisms which might be accidentally present. He found it in the acute stage of the disease, both in the male and female subject, and also in gonorrhœal conjunctivitis, but in no other conditions. This organism is now generally known as the micrococcus of gonorrhœa, or Neisser's *Gonococcus*, and his statements have been in the main confirmed by other observers. Attempts to cultivate it followed, but we now know that many of the earlier statements with regard to pure cultivations of this organism are erroneous, as these were made on media on which it does not grow. Later, however, several observers, by using human blood-serum as the culture-medium, have succeeded in isolating the gonococcus, and in cultivating it through many generations; and inoculation-experiments on the human subject have practically proved it to be the cause of the disease. (*See* the papers of Leistikow, Krause, Bokai, Bockhart, and especially the monograph of Bumm, *Der Gonokokkus Neisser*, Wiesbaden, 1887.)

Fig. 80.—Micrococci of Gonorrhœa in the discharge from a case of acute gonorrhœa. The cocci are seen mostly as pairs or groups of four, and are mainly in the protoplasm of the pus-cells. × 850.

On microscopical examination this organism is found to be of the diplococcus variety, nearly all the cells being arranged in pairs, single spherical cocci being comparatively rarely seen. The two members of a diplococcus have often their adjacent sides flattened, or even slightly concave, so as to appear like two small beans placed side to side. In some, transverse division of the two halves is seen, and distinct tetrad forms thus occur (*see* fig. 80). They never grow in the form of chains. These characters, which are seen both in gonorrhœal pus and in cultivations, were at one time thought to be characteristic of the gonococcus, but have now been found to belong to many diplococci. The size varies according to the phase of development, but a fully formed diplococcus measures about 1·5 μ in length.

The micrococci of gonorrhœa stain readily with the basic aniline colours; and their presence in gonorrhœal pus can be very readily demonstrated by staining dried films for thirty seconds in a strong watery solution of fuchsin

or a saturated alcoholic solution of methyl blue, then washing in water, allowing to dry, and afterwards mounting in balsam. They readily lose the stain when treated with decolorising agents, and accordingly are not stained by Gram's method. In the pus from gonorrhœa the organisms have a special relation to the pus-corpuscles, being found in large numbers, and almost exclusively, within their protoplasm, never in the nuclei. They are arranged in pairs, tetrads, or in small heaps, and sometimes they fill the corpuscle almost completely, giving the appearance of a small darkly stained ball of cocci. In the early stages, when the secretion is glairy and translucent, the organisms also occur free and in the epithelial cells; but when it is distinctly purulent almost all are within the pus-corpuscles.

In the early acute stage of gonorrhœa they are present in large numbers (according to Bumm no other organisms occur then in the male urethra, and pure cultivations can be made); later they become less abundant; whilst in chronic cases it may be impossible to detect any. We cannot enter here into the discussion regarding the relation of the gonococcus to the various concomitants and sequelæ of gonorrhœa, but it may be stated that many at least of these are due to the entrance of other organisms, such as pyogenic staphylococci. It has been stated that the organism may be found in the joints affected with gonorrhœal rheumatism; but this is doubtful. In blenorrhagic conjunctivitis it is found in the secretion along with other organisms, though it has the characteristic relation to the pus-corpuscles; whereas in conjunctivitis of non-gonorrhœal origin it is never found.

The cultivation of gonococcus outside the body is attended with considerable difficulty; and, while a certain amount of growth does take place on some other media, solidified blood-serum (especially human) is found to be the most suitable medium. To obtain cultures on this medium, small quantities of gonorrhœal pus should be placed in little heaps, and the pus must be free from other organisms. The best temperature is from 34° to 37° C., and below 25° growth practically comes to a standstill. Even at a suitable temperature growth is very slow. It is generally visible on the second day after inoculation, and appears as a minute circular film on the surface, almost colourless, showing a varnish-like appearance, with sharply marked edges, which often run out into little processes. The growth spreads slowly, and never reaches a large size. About two to three days after its first appearance it comes to a standstill, and a few days later all the organisms are found to be dead. By making fresh cultures at suitable times, however, it can be kept alive through an indefinite number of generations. When a microscopic examination of the growth is made, it is found that a considerable number of cocci, even in a recent cultivation, are in a state of degeneration, thus showing that their duration of life is short. In cultivations they are very easily killed, both by high and low temperatures, and they show comparatively little resisting power to chemical antiseptics.

Animals appear to be insusceptible to the disease, and all attempts to produce it by inoculations, whether of pure cultivations or of gonorrhœal pus, have failed. On one or two occasions, however, experiments have been performed on the human subject, the first being by Bockhart, who inoculated the urethra of a general paralytic and produced the disease. In this case, however, there must have been some fallacy, as the inoculation was made from a peptone-gelatine culture, on which medium the organism does not grow. Probably some of the original pus may have been present in the material injected, or the condition produced may have been a septic inflammation. Bumm, however, in two cases inoculated the healthy urethra with pure cultivations, in one case of the second, in the other of the twentieth, generation, and produced gonorrhœa, which showed all its typical clinical symptoms, and ran an ordinary course, the organisms being found in large numbers in the pus in proportion to the activity of the disease. It has also been found that when inoculations are made on the human subject with the pus of chronic gonorrhœa in which no gonococci can be found, no result follows.

In gonorrhœa there is therefore present a specific organism—a micrococcus—which is distinguished from all others by certain characteristics, especially by its conditions and manner of growth on various media. Whenever the disease is in an active stage these organisms are present in large numbers; in fact, the activity of the disease is associated with active proliferation of the micrococci. Moreover, the few experiments performed on the human subject entirely confirm the view that they are the causal agents in the production of the disease. The morphological characters of this organism, its reaction to stains, and its relation to the cells in the secretion, though possibly not absolutely peculiar, still, when taken collectively, are sufficient to form an aid in the diagnosis of gonorrhœa.

6. **Pneumonia, Acute.**—The common form of acute lobar pneumonia presents many resemblances to an acute specific fever, both in the comparative regularity of course and duration, the sudden defervescence, and the regular erysipelas-like spread in the lung. Instances of infection and of epidemic occurrence are not wanting, although in the great majority of cases no such evidence is at present available. But the analogies with

acute infective disorders are sufficiently striking to encourage research.

Of the kinds of micro-organisms which have been discovered in the pneumonic lung, two have especially gained prominence, Friedländer's and Fraenkel's pneumonia bacilli. Both have been found in a large number of cases by various observers, but at present the evidence of the causal relation of either to the disease is not sufficiently conclusive.

Friedländer's pneumonococcus or, more correctly, bacillus, was the earliest discovered. He found it in the lung-tissue, especially in the exudation in the air-cells, and in the lymphatics of the affected lung, in very numerous cases, and it has also been very frequently found in the sputa. These bacilli were cultivated by Friedländer in various ways. His observations have been repeated by many others, and their substantial accuracy cannot be questioned, so far as the frequent presence and general characters of the organism are concerned. The writer has frequently cultivated them from sputa, and also from fluid aspirated from the lung and from the pleura in cases of acute pneumonia.

Their characters may be briefly described. As seen in sputa, sections of the lung, or cultivations, they consist of short oval or oblong cells, arranged singly, in pairs, or short rows. They approach so nearly to a spherical shape that they were described by Friedländer as micrococci.

Within the body and in sputa, many of them appear to be surrounded by a hyaline capsule or clearer space, which may include single cells or short rows, and may be specially stained. This character, which was regarded by Friedländer as distinctive, is now known to be present in many other bacteria, and is simply due to gelatinous softening of the cell-wall, as already described.

The organism may readily be cultivated on peptone-gelatine, at normal temperatures, though it grows better at 35° C. It grows especially well on the surface, producing an elevated rounded mass, which, with the growth along the needle-track, causes an appearance which may be likened to a nail or pin, a character regarded as peculiar by Friedländer. It does not liquefy the jelly. It grows also on potatoes and on blood-serum.

Inoculation with these cultivations Friedländer found to produce pneumonia and pleurisy in mice, with reproduction of the organism in the pleural fluid, the lung, and the blood. The spleen was greatly enlarged and indurated. In guinea-pigs and even in dogs similar results were produced, though exceptionally. Rabbits were unaffected.

It has been objected to Friedländer's experiments that the method adopted, by injection into the lung, was faulty, and only showed the production of septicæmia with local inflammation. Nor does the fact that in a small number of cases inhalation of the organism produced a similar effect remove this objection. It can only be said that this organism is poisonous to mice and causes intense local inflammation and septicæmia in them, but this in nowise suffices to prove its special relation to pneumonia. Moreover, an apparently identical bacterium, similarly virulent, has been cultivated from the secretions of the mouth of healthy persons, and appears to be commonly present there.

It was pointed out by Afanassiew that another bacterium, differing from the preceding in size and shape, was also often present in the lungs and the sputum in pneumonia. This, which has been more fully studied by A. Fraenkel and G. Weichselbaum, and is known as the Fraenkel or Fraenkel-Weichselbaum pneumonia bacillus, has been found

FIG. 81.—Acute Pneumonia.—Dried sputa from a case of pneumonia, showing the Streptococcus lanceolatus, and some other Strepto- and Diplococci. × 950 diam.

to be very commonly present in the lungs and in the rusty sputum in cases of pneumonia, especially during the earlier stages. From its shape it has also been called the Diplococcus lanceolatus, and is also known as the Diplococcus Pasteuri. It is in reality a bacillus. In shape it is like a short spindle partially divided into two halves, each of which is lancet-shaped. The double cells may form short chains. Like Friedländer's, this bacillus shows a capsule when within the body, but not in cultivations. It can be cultivated on nutrient jelly, agar, or blood-serum, and still better in broth. It grows best at about 35–37° C., but can be grown on jelly at 24° C. or a little higher, forming small, rounded, translucent, whitish points. It does not grow at ordinary temperatures; and this fact, along with its comparatively slow rate of growth, makes its cultivation more difficult than Friedländer's organism. When grown outside the body it rapidly loses its virulence, and also its vitality, unless fresh cultivations are made.

Inoculations with these cultivations cause

septicæmia in mice, guinea-pigs, and rabbits, the latter animals being highly susceptible. Great swelling with induration of the spleen occurs, and rapid death, often in twenty-four to forty-eight hours. But no pneumonia occurs, nor pleurisy, unless the cultures are injected into the pleural cavity. Great development of bacilli takes place, and they are found in the blood and all the organs. In the human subject, these bacilli have been found in large numbers in the vegetations in septic endocarditis accompanying pneumonia.

These observations, which have been confirmed by numerous competent experimenters, would not suffice to prove absolutely any causal connexion with pneumonia. More suggestive, however, is the fact that when cultivations of the bacillus are weakened by exposure to a temperature exceeding 40° C. for several hours, and then injected subcutaneously into rabbits, some of them become very ill and some die after several days, and that in these there is found intense inflammation of the pleura and sometimes of the lung, with pneumonic consolidation. Moreover, according to Gamaleïa,[1] successive cultivations in rabbits greatly intensify the virulence, and large doses of the intensified cultures will kill sheep, or, if injected into the lungs of sheep or dogs (which are highly resistant), set up intense pneumonia.

Even these facts do not remove the bacterium from the category of septicæmia-producing bacteria; and the experiments of Monti, who produced pneumonia by injection into the trachea, have not been confirmed. Moreover, a similar bacillus has been found in many cases of pleurisy, peritonitis, peri- and endocarditis; and, according to Foà and Bordone-Uffreduzzi, it is almost constant in epidemic cerebro-spinal meningitis. And, according to Netter, it is common in healthy oral and nasal secretions.

Further investigation is necessary to prove their specific relation to the disease.

GROUP II.—*Diseases due to Infection of Wounds by Bacteria which are common in the Soil, &c.*

7. **Malignant Œdema.**—Space allows us to state only a few facts regarding the bacillus of malignant œdema—an organism discovered by Koch (*Arbeit. aus d. Kais. Gesundh.* 1881, Bd. 1). In its morphological characters it presents certain points of similarity to the bacillus anthracis, but in its conditions of life and manner of growth it is widely different. It is a large bacillus, though somewhat less, especially in thickness, than the anthrax bacillus. The rods are found growing separately and also in chains, the latter condition being seen especially in cultivations. They have distinctly rounded ends, and the spores, which are formed under certain conditions, are larger than the diameter of the bacillus, so that a slight bulging is formed either in the centre or towards the end. Spores are not formed in the living body. The rods are motile, and recently lateral cilia have been demonstrated.

This bacillus grows readily on the ordinary media, both at the body-temperature and also at lower temperatures, but only under strictly anaërobic conditions. If liquid gelatine-medium be inoculated (better with glucose added), and then allowed to solidify, growth occurs only in the deeper parts of the medium. The colonies produce little opalescent spheres of liquefaction, and small bubbles of gas appear in connexion with them. The growth has a peculiar heavy but not putrid odour.

The bacillus occurs very widely in nature, being found in garden earth, in fæces, in decomposing fluids, &c. It is pathogenic to most animals, though cattle are said to be immune. In rabbits and guinea-pigs, for example, its inoculation is followed by the occurrence of a spreading subcutaneous œdema, with the formation of small bubbles of gas, and death generally occurs in about two days. Until after the death of the animal, the organisms are not as a rule present in the blood. When other putrefactive bacteria are introduced along with it, as in inoculation with garden earth, &c., the development of gas is more marked, and the infiltrated tissues become very putrid.

In several cases of progressive gangrenous emphysema in the human subject this organism has been found to be present in large numbers, and is probably the chief causal agent, though its effects are aided by the concomitant growth of other bacteria, the condition generally arising from a wound into which soil or other septic matter has entered.

This bacillus is one of the organisms against which immunity can be produced by the injection of its soluble products.

8. **Tetanus.**—Until recently, tetanus was usually regarded as a disease of the nervous system, due to peripheral irritation. But many facts, and especially its analogies with hydrophobia, have long suggested its infective origin. Recent discoveries have not only established this, but have greatly advanced our general knowledge of bacteriology by the light thrown on other diseases.

The first demonstration of the transmissibility of tetanus by inoculation was given by Carle and Rattone of Turin in 1884. Their experiments were made on rabbits, by injecting an emulsion of the wounded tissues from a patient who died of tetanus. In the same year A. Nicolaier of Göttingen succeeded in producing tetanus in mice, rabbits, and guinea-pigs by subcutaneous inoculation of earth. In the pus from the wounds

[1] *Ann. de l'Inst. Pasteur.* 1888, p. 400.

Nicolaier found a bacillus which presented peculiar characters, together with others commonly found in suppurating wounds. Inoculation of other animals with pus from the wounds gave rise to tetanus in them, with reproduction of the same bacillus, but not in a state of purity. Attempts to cultivate the bacillus proved unsuccessful. In 1886 Rosenbach found the same bacillus in the wound in a fatal case of tetanus in man, and produced tetanus by inoculation from the wound, and from impure cultivations from the bacillus at the fourth generation. And although Rosenbach did not succeed in cultivating the special bacillus in a pure condition, he was able to exclude the other forms present in the cultivations as causes of tetanus, by cultivating them apart and inoculating in other animals.

The first successful attempts to isolate and cultivate the tetanus bacillus were published by Kitasato in 1889 (*Zeitschr. f. Hygiene*, Bd. vii. p. 225). Cultivations of pus from a case of tetanus were allowed to grow for forty-eight hours at the temperature of 38° C. They were then exposed to the temperature of 80° C. for three-quarters of an hour to one hour. This had the effect of killing all except the tetanus bacillus (or its spores). Cultivations made from the residue in an atmosphere of hydrogen succeeded in peptonised broth, gelatine, or agar.

The bacillus thus obtained appears to correspond with that previously described by Nicolaier. It grows freely only in an atmosphere devoid of oxygen, and is therefore strictly anaërobic. That it can develop in the presence of other aërobic bacteria may possibly be due to their action in absorbing the oxygen. It grows best at a temperature of 36-38° C., the spores appearing at the end of thirty hours. Below 14° C. its growth ceases; between 20° and 25° C. it is very slow, and spores do not appear for seven or eight days. The spores show great resistance to heat and drying; a moist heat of 80° C. for an hour does not kill them, and the spores can be kept in a dry condition for some months, still retaining their activity. Water or steam of 100° C. kills them in five to fifteen minutes; steam at 115° in five minutes with certainty. Cultivations made in the manner described retain their virulence during successive generations.

When grown in gelatine-medium the colonies usually commence as slightly cloudy points, from which radiate very fine thread-like branches. Liquefaction occurs, but somewhat slowly. If any oxygen is present, the growth occurs most readily in the deeper parts of the cultivation.

The bacillus itself is very minute, and may be seen in rods from 3–5 μ in length, growing to filaments. The diameter averages about ·4 μ. The bacillus is slightly motile. In cultivations it forms spores which are nearly spherical or ovoid in shape, and exceed the rods in diameter, being sometimes more than four times as wide. Hence, when division occurs between the spores, as is frequently the case, the bacillus resembles a pin or tambour in shape, a point which has been regarded as characteristic. But whilst this fact may aid in its distinction amongst the bacteria from wounds, it cannot be considered as in reality distinctive from other bacteria in general; though there are other peculiar characters, as seen in the woodcut, not described in other bacteria, and new to the writer. The bacillus is readily stained by any of the ordinary methods with various aniline dyes.

The remarkable resistance of the spores has already been mentioned. Putrefaction

FIG. 82.—Tetanus Bacilli.—From a culture, stained by Löffler's method for showing flagella. From a specimen obtained from the Berlin Health Laboratory. Magnified 2,000 diameters. In addition to the peculiar shape, due to the large terminal spore, other peculiar morphological features will be observed: the character of the flagella, the apparent flagellation of the spores, and their relation to the bacilli.

of the tissues containing them does not affect them. Their degree of resistance to antiseptics appears also to be great. Carbolic acid (5 per cent.) applied for ten hours has failed to kill them, and corrosive sublimate, 1 in 1000, requires more than three hours (Sanchez Toledo and Veillon).

General relations to the disease.—Up to the present time there is some conflict of opinion as to the exact distribution of the tetanus bacillus within the body; but from a general summary, and especially from a valuable series of experiments by Sanchez Toledo and Veillon (*Arch. de méd. exp.*, tom. ii. p. 709, 1890), the following would appear to be the probable condition.

The bacillus when inoculated multiplies in the wound, especially in the deeper parts, producing some little irritation, but no suppuration, although this may occur from the presence of other organisms. It does not pass into the blood, or only in a very

small degree, until a somewhat later period, and especially during the later hours of life. Hence it may not be found in the internal organs; and the brain, spinal cord, liver, or spleen of animals which have died of tetanus may be inoculated into other animals without result. This is, however, only the case if the material for inoculation is taken shortly after the death of the animal; for multiplication of the bacillus takes place after death, and the organs thus become more virulent.

It appears also that the multiplication of the bacillus in the tissues near the wound is often very scanty—so scanty that some observers have alleged that it only takes place for a short time after inoculation. Indeed, Vaillard and Vincent find that if pure cultivations be injected into animals, practically no multiplication of the organism takes place, and that the tetanic symptoms produced are really due to the poisonous products of the bacillus already present in solution in the culture.

In inoculated animals the earliest tetanic symptoms commence in the muscles adjacent to the wound, and later become generalised. They may commence within a few (eight to thirty) hours, and death may occur in twenty-four hours to three days in mice, white rats, rabbits, and guinea-pigs; but in some animals (dogs, fowls) they may be delayed for six days or even longer.

It would appear that this bacillus is widely diffused in the soil; and, according to Sanchez Toledo and Veillon, it is commonly found in the fæces of healthy horses and oxen. They believe that it can readily develop there, owing to the relative deficiency of oxygen in the intestines. There can be little doubt that it must, if this is the case, have a saprophytic *rôle* in nature, in addition to its pathogenic effects.

Lastly, it has been found that animals which have recovered from inoculation of the tetanus bacillus have not acquired an immunity to subsequent inoculations.

Dr. Sormani of Pavia (*Inter. Med. Congress*, 1890, *Trans.*, vol. v. p. 150) has recorded an extensive series of observations which, in the main, confirm these results. But he found that the Clostridium fœtidum of Liborius, which very commonly accompanies the tetanus bacillus in fæcal matter, cannot be killed by the exposure to 80° C., as its resistance to heat is nearly as great as that of the latter. It withstands even 100° C. for an hour. Hence it is difficult to obtain pure cultivations of the tetanus bacillus from fæces. But since this clostridium has a powerful reducing action whilst growing, its presence facilitates to a remarkable extent the growth of the tetanus bacillus, by removing the oxygen. His experiments also showed that inhalation of the tetanus bacillus does not produce the disease, and that when swallowed in large quantities it does not affect the animal; although by its multiplication in the intestine the fæces become very virulent. He was able also to implant subcutaneously a minute tube containing cultivations of the bacillus, in such a way that the toxic matter could filter out without the bacilli, and found that tetanus was nevertheless produced. This confirms the results of other observers, that the direct action of the bacillus on the system is by means of a diffusible poison, which is generated in the wound and thence absorbed.

During the last two years a large number of investigations on the poisonous products of the tetanus bacillus have been carried on, in a manner similar to that described later in the case of diphtheria. Such investigations have been conducted in Italy, France, and Germany, and there is a considerable agreement amongst the most important results independently obtained. It is found that virulent cultures made free from bacilli by filtration produce all the symptoms of the disease with great readiness when injected into animals. Brieger and Fraenkel affirmed the poisonous substance to be a toxi-albumen; but Tizzoni and Cattani on the one hand, and Vaillard and Vincent on the other, came to the conclusion that it is of the nature of a soluble enzyme or ferment. Tizzoni and Cattani (*Centralb. f. Bakt.* 1890, ii. 69), by dialysis of the filtrate of a virulent culture, and subsequent evaporation to dryness, obtained a yellowish crystalline-looking powder, which at least contained the active substance, though not in a pure form. This poison possesses extremely active properties, half a cubic centimetre of a filtered virulent culture being sufficient to kill a rabbit, and ·05 milligramme of the organic matter precipitated from such a filtrate by calcium phosphate causing marked symptoms (Vaillard and Vincent, *Ann. de l'Instit. Past.* 1891, p. 1). The poisonous properties are, however, very easily destroyed by heat, by chemical agents, and in other ways. Exposure to a temperature of 60° C. completely deprives filtered cultures of their virulence, and exposure to sunlight for eighteen hours has a similar effect (Kitasato). The poisonous effects follow when it is injected, either into the blood or subcutaneously; but when injected into the stomach, or when swallowed, it has no effect. These results, and many others, show that the tetanus poison is a very unstable substance. The tetanus bacillus also produces a peptonising ferment, which is destroyed at the same temperature as the poison, but the identity of the two substances has not yet been established. The poison is present in the blood of animals which have died of tetanus, and when the blood or its serum is injected in sufficient quantities into a susceptible animal, such as a mouse, tetanic symptoms result. Guinea-pigs are the most susceptible animals, whilst in

dogs the symptoms are much later in appearance and less marked.

Important advances have also been made towards producing immunity against this poison, and probably also towards curing the disease in certain cases. Tizzoni and Cattani (*Centralb. f. Bakt.* 1891, i. 189) found that by injecting small doses of the tetanus poison into dogs repeatedly for a time, an immunity against large doses of the poison was produced in them. They found that the serum of such animals had a directly antagonistic action to the tetanus poison, and when added to filtered tetanus-cultures deprived them of their virulence. Also the serum of immune dogs, when injected into mice, conferred a similar immunity on them. Later, by a somewhat more complicated method, they succeeded in making guinea-pigs and rabbits immune. They have also conducted an extensive series of researches on the nature of the substance in the serum which produces the immunity, and have found it to correspond in its chemical relations with a globulin having the properties of an enzyme. This substance they have called 'tetanus antitoxin.' Behring and Kitasato (*Deutsch. med. Woch.* 1890, No. 49), a short time before, succeeded in producing immunity in rabbits against the poison, and found that ·2 c.c. of the serum of an immune rabbit injected into a mouse conferred immunity on it. As an example, a rabbit rendered immune could withstand the injection of 10 c.c. of a virulent tetanus culture, of which ·5 c.c. was quite sufficient to kill with certainty an unprotected animal. They also obtained the same result as Tizzoni and Cattani, with regard to the antagonistic action of the serum of immune animals to the tetanus poison outside the body. All these observers also found that in the case of mice in which tetanic symptoms had set in, a cure could be produced by the injection of the serum of immune animals, if the dose of the poison were not excessive, and if the disease had not advanced too far. The immunity artificially produced in these animals disappears after a time.

Special interest attaches to the application of these results to the treatment of the disease in the human subject. The first case treated successfully was by Gagliardi; the second by Schwarz, of which a full account is given in *Centralb. f. Bakter.* 1891, ii. p. 785. The latter employed tetanus antitoxin prepared by precipitation by alcohol from the serum of an immune dog, and subsequent evaporation to dryness *in vacuo*. The case was one in which all the symptoms of tetanus were well-marked. Injections of the antitoxin were made on three occasions in doses of 15, 25, and 25 c.g. respectively. Little result followed after the first injection, but marked improvement occurred after the second; and after the third the symptoms quite disappeared, and complete cure resulted. Several similar cases have occurred since, the number in which favourable results have been obtained being seven at the present date (September 1892). Still more extended observations are necessary before a definite statement can be given regarding this method of treatment in general.

As practical conclusions, it is evident that the main cause of tetanus is the introduction into a partially closed wound of material containing this bacillus or its spores, and that this is especially liable to occur where fæcal matter is abundant.

Its life-history also indicates the great importance of freely opening wounds in which foreign bodies have become fixed, in order to avoid the anaërobic condition; and it explains the fact that, even after the onset of tetanic symptoms, free excision of the wound has occasionally proved of service.

The great resistance to ordinary disinfectants and antiseptics necessitates the use of the strongest possible, and an acid solution of corrosive sublimate of 1 in 500 strength is needed. The use of iodoform has also occasionally been found of service in experiments, but only when in the presence of other bacteria which can decompose it.

It may be added that experiment seems to prove that the so-called 'idiopathic' or 'rheumatic' tetanus, 'head tetanus,' and also 'trismus neonatorum,' are due to the same organism.

Group III.—*Specific Infective Diseases, usually transmissible by inoculation, attended by inflammatory changes which frequently become chronic, and usually associated with the formation of specialised granulation-tissue growth ('infective granulomata') throughout the body.*

9. **Tubercle.**—Before anything was definitely known regarding bacteria as the causal agents in the production of tubercle, it had been proved by experiment that it was a directly inoculable disease. Villemin produced general tuberculosis by the introduction of caseous material into the subcutaneous tissue of animals; and Cohnheim and Salomonsen inoculated the anterior chamber of the eye of the rabbit, and produced in this way a tubercular affection of the iris, characterised by the growth of small grey nodules—a condition which does not occur spontaneously in these animals. (Béhier and Liouville had previously made similar observations.) They found also that this condition might be followed by a general tuberculosis. These experiments showed that in tubercular material there is some virus capable of propagating itself and giving rise to the characteristic lesions. To Koch belongs the credit of first discovering the nature of the virus, by demonstrating the constant

presence of bacilli in tubercular affections, by isolating and cultivating those organisms, and lastly by inoculating with them and producing the disease. His work in this discovery is an excellent practical example of the canons laid down by himself for proving the bacterial nature of any disease.

The announcement of the discovery of the bacillus of tubercle was made by Koch in 1882, and a full account of his work appeared in the following year in the *Mittheil. a. d. Kaiser. Gesundheitsamte.*

For a time Koch's endeavours to demonstrate the presence of organisms in tubercle, by means of the methods of examination and staining then in use, were unsuccessful. But he ultimately found that by subjecting the tissues for a long time to the action of a solution of methyl blue, rendered alkaline by the addition of caustic potash, which increases its penetrating power, the presence of bacilli could be revealed. This original method was replaced by a better one, namely, the staining of the tissues for twenty-four hours with gentian-violet solution in aniline-oil water. He found that when stained in this way the bacilli retained the stain even if treated with strong mineral acids. By the employment of dilute nitric acid (one part in two of water) he could remove the stain from the tissues and other organisms, leaving these bacilli coloured. One exception he found, namely, the bacilli of leprosy, which react to the stain in the same way, though they hold it with rather less tenacity. He then coloured the tissues by a contrast stain, such as Bismarck brown. All other methods of staining subsequently devised depend upon the same

FIG. 83.—Tubercle Bacilli.—*a.* From section of lung. *b.* From sputum. *c.* From section of tubercular ulcer of intestine. × 850 diam.

principle, namely, that these bacilli can only be stained by a solution of strong staining power (generally a solution of fuchsin or gentian violet, with a suitable mordant), and when thus stained they can be subjected to powerful decolorising agents without losing their colour.

Characters of the tubercle bacillus.—The organism thus discovered by Koch, and now known as the *Bacillus tuberculosis* or *tubercle bacillus*, is of comparatively small size, measuring as a rule 2·5-4·5 μ in length, and about ·3 μ in thickness, so that relatively to its length it is a thin bacillus. The rods are straight or slightly curved. They are generally found singly; often two are joined in a straight line or at an obtuse angle; but in the tissues they rarely form longer rows, though these are common in cultivations. Occasionally in the tissues, very frequently in phthisical sputum, and also in old cultures, an appearance may be seen in the bacilli which suggests the occurrence of spore-formation. This consists in the presence of clear globular unstained spaces in the bacilli, there being sometimes three or four such in a single rod, and arranged so regularly as to give the appearance of a row of cocci (*see* fig. 83). These uncoloured portions refract the light highly, and microscopically many of them have certainly the appearance of spores, though this cannot be held to be definitely proved.

The bacilli may be found wherever the growth of tubercle is going on, though in varying numbers, according to the rapidity and character of the growth. As a rule, it may be said that the more acute the tubercular process, the more numerous are the bacilli. In recently formed, rapidly growing tubercles, they are generally present in large numbers, even in the central parts which are showing signs of degeneration; whereas in chronic fibroid tubercles they may be very few in number; and in old caseous material, as a rule, their presence cannot be demonstrated. Sometimes in the nodules in which caseation is going on there can be seen in the degenerating parts bacilli which stain imperfectly, and have lost their distinct form; or only a few granular remains may be seen, some of which may be spores. This is the more likely, as caseous material has been found capable of producing tubercle on inoculation, though no tubercle bacilli could be demonstrated in it. The bacilli, as seen in the tissues, are sometimes scattered fairly uniformly, sometimes closely gathered in little clusters, and may occur partly within cells, partly lying free. Frequently in bovine tuberculosis, more rarely in the disease in the human subject, they may be seen to have a special relation to the giant-cells. In these cells the bacilli often form a sort of ring or zone towards the periphery, and are sometimes arranged in a radiate manner (*see* fig. 84). They are generally found apart from the nuclei, and the protoplasm of the giant-cell often shows a granular and partially degenerated appearance. In acute caseous catarrhal changes in the lungs, they may often be found in very large numbers in the contents of the air-cells, especially where the process

is spreading. In some very acute forms of the disease they may sometimes be seen in parts in which no distinct tubercles have yet formed; the writer has seen this very well in the spleen in acute tuberculosis. In the sputum of phthisical patients their presence can generally be revealed with comparative ease, and for this purpose Neelsen's carbol-fuchsin method is probably the most suitable. In order to find them, one of the small yellow caseous-looking masses in the sputum ought to be selected, broken down between cover-glasses, and treated as above described (*vide* Modes of Staining). They are generally

Fig. 84.—Tubercle Bacilli in section of a cow's udder. Showing relations of bacilli to a giant-cell. × 850 diam.

found in little groups, sometimes in very large numbers, and occasionally so closely massed together as to make the recognition of individual bacilli difficult. They may also, of course, occur singly here and there. They may also be demonstrated in the urine in cases of renal phthisis, in the dejecta in tubercular ulceration of the intestine, and in the milk of cows with tubercular udders.

Cultivation.—Koch's first attempts at cultivation on the media then in use were unsuccessful, but he ultimately succeeded on blood-serum prepared by an ingenious method. He sterilised it by heating to 55° C. on successive days—sterilisation by steam being inadmissible, on account of its coagulating the albumen, and rendering the medium opaque; and subsequently inspissated it at a temperature of 65° C. The medium thus obtained is transparent, semi-solid, and sterile. As the presence of other organisms requires to be rigorously excluded, he first employed for inoculation portions of tubercular material from animals, which of course could be obtained from them in a perfectly fresh condition. The skin of the animal having been previously purified by washing with an antiseptic, and all the scissors, knives, &c., used in the operation having been sterilised by heat, he dissected out portions of the nodules, and made inoculations on the serum. For the first few days no signs of growth were observed, but generally on the tenth to the fourteenth day the growth made its appearance. It first appears as a small whitish point, which gradually spreads on the surface of the medium, becoming more distinctly white or yellowish-white; and ultimately forms a small scale-like film of wrinkled appearance. The growth progresses slowly throughout, and after a week or two comes to a standstill. It never penetrates into the surface of the medium, and causes no liquefaction. In meat-broth growth is very imperfect, and occurs only when the liquid is in a thin layer, as the organism is strictly aërobic; but on glycerine-agar, as Nocard and Roux first pointed out (*Annal. de l'Inst. Past.* 1887, p. 19), the growth both appears at an earlier date, and is more rapid and abundant than on blood-serum. But the successive cultures tend to diminish in vitality and virulence. The young colonies on solid media, when examined with a low power, show characteristic appearances which, so far as is known, are quite peculiar to the tubercle bacillus. The margins of the growth have the appearance of wavy bundles of hair running in a sinuous manner, whilst those bundles in the central portion give the appearance of a number of laminæ intertwined. The bundles, or laminæ, are composed of bacilli arranged in a parallel manner. It was for a long time believed that the bacillus could grow only on animal media, but Pawlowsky (*Annal. de l'Inst. Past.* 1888, p. 303) has since found that growth takes place also on potatoes kept at a suitable temperature, if the tubercular material be well rubbed in, and the surface of the potato kept moist. When examined in fluids, tubercle bacilli exhibit no power of independent movement.

The cultivation of tubercle bacilli directly from *post-mortem* material, from sputum, &c., where many other organisms are present, is very difficult, on account of their slow rate of growth. But it has been effected by one or two very ingenious expedients, which it is needless to detail. Cultivations may, however, be made with comparative ease indirectly, by inoculating animals with the tubercular material, and then using some of the nodules produced for inoculation on the culture-media.

Tubercle bacilli flourish best at a temperature near that of the normal body. Koch found that on blood-serum growth took place readily between 30° and 40° C., that about 37° C. is the most suitable temperature, and that below 28° C. and above 42° C. growth does not take place. On glycerine-agar the temperature limits are rather more extended.

Relation to the disease.—That this organism is really the cause of tubercle was proved by Koch by a very extensive series of experiments on animals, by inoculation both of tubercular material containing the bacilli, and of pure cultures. His results have been

amply confirmed by a very large number of subsequent workers. Its pathogenic properties were tested by Koch in a great many ways: by injecting the bacilli into the subcutaneous tissue, into the anterior chamber of the eye, into the peritoneum, into the veins; by feeding animals with material containing the bacilli; by distributing the organisms in the air to be respired by the animals. In many cases the bacilli used were from cultures which had been carried through more than twenty generations. By all these various methods tubercle was produced, differing of course in its anatomical characters and distribution in the different methods. The result depends somewhat on the number of bacilli introduced; thus, a small number introduced into the anterior chamber of the eye produces a growth of small grey tubercles, while a larger number causes a general caseous infiltration. Tubercle bacilli of the same culture also produce somewhat different tubercular lesions in different kinds of animals. A single example may be given of Koch's many experiments. Tubercle bacilli taken from a culture of the twenty-third generation were mixed with sterile water, and 50 c.c. of the mixture were distributed on three successive days by a spray apparatus in a box containing a number of rabbits, guinea-pigs, rats, and mice. Some of the animals died, the others were killed twenty-eight days after the last inhalation, and in all of them tubercular lesions were found in the lungs.

From the above statements with regard to the temperatures at which tubercle bacilli grow, it is evident that their growth in natural conditions is practically limited to the bodies of warm-blooded animals. But while this is so, they can retain their vitality for a considerable length of time at ordinary temperatures, whether in the dry or in the moist condition. It has been proved that phthisical sputum kept in the dry state for more than two months still contains living tubercle bacilli, and that when kept in sterilised water the bacilli are still alive at the end of two months. The process of putrefaction which kills many pathogenic bacilli appears in many cases to have little effect upon tubercle bacilli, and tuberculous sputum allowed to putrefy for several weeks has been shown by inoculation to contain living tubercle bacilli (Fraenkel, Baumgarten). Many experiments have been performed on their resistance to heat and chemical reagents by Koch, Schill and Fischer, Baumgarten, Voelsch, and others. Only one or two facts can be mentioned. Sputum containing a large number of bacilli loses its infective properties by being thoroughly exposed to the action of carbolic acid (2-3 per cent.) for a few minutes (Schill and Fischer, Baumgarten). They are, however, much more easily killed, whether apparently spore-containing or not, when in pure cultivations (Yersin). Other antiseptics act in a similar way; but some, such as corrosive sublimate, are unsuitable on account of the coagulum they form on the surface of the sputum. They show a comparatively high resisting power to the action of the gastric juice, experiments having been made, both with natural and artificial gastric juice, on tubercular sputum, and other materials, and on cultures (by Falk and Wesener). It has been found that tubercle bacilli from pure cultures, after being acted upon by the gastric juice of a dog for six hours, are still virulent when injected into animals. It is therefore evident that bacilli in meat, milk, and the like, if not killed before being swallowed, will probably pass into the intestine in a living state. Moist heat at a temperature of 100° C. kills the bacilli in any condition in a few minutes; the bacilli in moist sputum are killed more quickly than when the sputum has been thoroughly dried. In cultivations, at least, much lower temperatures are sufficient—70° C. (Yersin). For disinfecting purposes, however, the higher temperature should be used. Dried sputum requires to be exposed to dry heat at a temperature of 100° C. for sixty minutes in order to kill all the bacilli with certainty.

Statements disagree regarding the comparative resistance of tubercle bacilli with apparent spores, and of those in the supposed spore-free condition. Some have found a considerable difference, whilst others have failed to find any. The important practical point, however, is to know the greatest resisting power of the organism in any condition, and the above statements have been given with this end in view.

As is well known, tubercle bacilli may gain entrance to the body by the respiratory passages, by the alimentary tract, and by external wounds. Direct experiment would appear to prove that in the case of the air-cells of the lung, and the intestinal mucous membrane, they can produce tubercular lesions without the presence of previous catarrh or any other abnormal condition. Numerous examples of direct inoculation of mucous surfaces in the human subject are afforded by *post-mortem* examinations.

Speaking generally, we may say that in experiments on animals the result of direct inoculation with tubercle bacilli (*e.g.* by injecting subcutaneously or into the anterior chamber of the eye) is to produce first local tubercular growth, and later a generalised affection. When introduced into the circulation in sufficient numbers, the bacilli produce an acute tuberculosis, though sometimes the animal may succumb before tubercles visible to the naked eye have been formed. As examples of the means of rapid extension from a tubercular focus in the human subject, may be mentioned the

distribution of caseous material containing bacilli by means of the air-passages to other parts of the lung, the rapid tubercular affection of serous cavities when the bacilli gain an entrance to them, and the general tuberculosis produced by the entrance of the bacilli into the circulating blood.

A few words may be said regarding the action of the bacilli on the tissues, and the mode of formation of tubercles. Careful experimental work on this subject has been done by Baumgarten, Cornil, and others, most of the results of which can be readily followed on specimens from the human subject. The first change produced by a local growth of the bacilli is a proliferation of the connective-tissue cells. The cells, by the irritation of the bacilli or their products, multiply by karyokinesis, and become 'epithelioid' in character, whilst a little later evidence of irritation is shown by emigration of leucocytes, which accumulate at the periphery. A little cellular nodule is thus produced around the bacilli. Soon an important change occurs in the centre of the nodule. The cells become swollen and translucent, their nuclei lose the power of staining, and the cells show a tendency to fuse together. This change, known as 'coagulation necrosis,' is soon followed by a granular disintegration, which often terminates in caseation. The giant-cells, which are specially seen in chronic tubercles, appear generally to be formed by the enlargement of the epithelioid cells, though there may be other methods of formation. The bacilli therefore act in two ways—first, by causing reactionary changes in the cells, evidenced by their proliferation; and, secondly, by producing degeneration in the cellular elements. The greatly different appearances of tubercular growths depend chiefly upon the rapidity and intensity of the proliferative and degenerative changes.

Practical conclusions.—The facts established by the bacteriological work done on this subject ought to have important practical results. That the sputum from cases of phthisis contains numerous bacilli, and that in many cases on its becoming dry the bacilli are disseminated in the atmosphere whilst still in a living and virulent condition, are facts beyond dispute. They have been demonstrated in the atmosphere, and in the dust of apartments containing phthisical patients, and have been proved by direct inoculation to be still capable of producing the disease. The danger arising from treating phthisical patients in the same rooms or wards with other patients is at once apparent, and there are numerous actual examples of infection in this way. By the isolation of cases of phthisis as far as this is practicable, and by the treatment of the sputum as infective material, much more than has as yet been attempted might be done to lessen the spread of the disease.

10. **Leprosy (Elephantiasis Græcorum).**—Until within a recent period this formidable disease had excited but little interest in this country, since its practical disappearance from our shores in the middle ages. Yet its wide prevalence and serious results in various countries under the rule of Great Britain might have led to more research as to its causes and cure. It will suffice here to deal with those aspects which most especially relate to its bacteriology.

The essential uniformity and identity of leprosy in its various manifestations are now generally admitted; and whether it is studied in the temperate or cold climates in Northern Europe, as in Norway, Finland, and North Russia, or in Newfoundland, or in Italy, Spain, India, Egypt, Syria, or in the islands of the Pacific, it is found to be the same in its morbid anatomy and clinical features.

The old view that it was a highly contagious disease has in more recent times given place to the notion that it is not contagious. But the evidence which is accumulating on all hands of its possible direct transmission, and of the spread of the disease in localities where it has been introduced (as into the Sandwich Islands in 1865), confirms the older view, which is in accordance with the results of bacteriological investigation. It is especially on this account that the study of its relation to micro-organisms is of such extreme importance.

The *morbid anatomy* of leprosy can only be touched upon so far as is necessary to explain what follows.

The various clinical forms, 'tubercular,' 'anæsthetic,' and so on, have a common anatomical basis. The nodular or diffused thickenings of the skin, the anæsthetic areas, the parchment-like, shrivelled skin, the ophthalmia, the paralysis of nerve-trunks, the atrophy of the cartilages and bones, and the wasting and shrivelling of the extremities, are all the direct result either of a chronic inflammatory or proliferative process in which granulation-tissue is formed and subsequently cicatrises, or of the chronic inflammatory changes in nerves and nerve-trunks.

Microscopic study of the morbid changes in leprosy before the discovery of the bacillus lepræ showed little to distinguish them from other chronic inflammatory changes, such as those of syphilis. The affected parts show diffuse infiltration with granulation-tissue, sometimes taking a nodular form, whilst the proper tissue-elements are being atrophied and absorbed. The only special feature observed was the presence of a rather unusual number of large cells, epithelioid in type, often with so-called vacuolation and vesicular swelling of the nuclei. These cells differ from the giant-cells of tubercle in their smaller size, absence of multiple nuclei, and irregular arrangement. From their peculiar abundance and character they are distinguished as

'lepra cells.' Absence of caseation was also noted as a character in which the new-growths of granulation-tissue differed from those of tubercle and syphilis.

In 1874 (*Norsk Magazin f. Lægevidenskab*, 1874, Heft 9; Virchow's *Archiv*. Band 79, p. 32) Dr. Armauer Hansen of Bergen discovered that the parts more especially affected by growths of leprosy, and particularly those in most active development, contained large numbers of bacilli. Further researches, first by Neisser in 1879, and since by many observers in all parts of the world, have established the constancy of their presence, and of their peculiar characters and relations to the diseased parts, and have confirmed the accuracy of Hansen's observations. As there has been much dispute as to their exact relations to the tissues, and as our knowledge on many points is yet very incomplete, it will be well only to state those facts which are best ascertained, most of which the

FIG. 85.—Leprosy.—Section of skin, showing superficial and deep parts of the same section. *a*. Exudation on surface of skin, showing numerous red blood-corpuscles and leucocytes, together with large cells. The bacilli are for the most part contained in these large cells. *b*. From deeper part of the same section, showing the relations of the bacilli to the cells and tissues. × 850 diam.

writer can confirm from his own observations, and to leave the disputed points for further investigation.

The *bacillus lepræ*, or *leprosy bacillus*, as seen in the tissues, very closely resembles the tubercle bacillus. It may be studied either in the juice expressed from one of the nodules (especially those in the skin), or in sections prepared and stained. In the first condition they are motionless (although some have stated that they may have a slow movement, this appears to be an error). They can be far more readily stained with ordinary aniline dyes than tubercle bacilli, and if stained in the same way as tubercle, they are rather more readily decolorised. They stain well with carbol-fuchsin, safranin, or gentian violet. Fuchsin with a contrast stain of methylene blue does well. It has been observed that some stains give a most definite appearance of bacilli. Others show a row of spore-like bodies (coccothrix), due to the fact that some parts of the bacilli are much more readily stained than the rest.[1]

The bacilli are usually straight, or very slightly curved, of nearly uniform thickness, rounded or slightly pointed at the ends. They always show the peculiar beaded or spore-like character of dots at fairly regular intervals, which have a different refraction, and different reaction to staining from the rest of the protoplasm. *See* fig. 85.

The tenacity of life of these bacilli when placed in a suitable position is very remarkable. In the numerous attempts which have been made to inoculate leprosy in animals, it has been found that even where no proliferation had, so far as could be judged, taken place, the bacilli remained in an apparently living condition in the subcutaneous tissue for several weeks or months.

These organisms are generally found in leprosy in large numbers, and have a special relation to the histological changes—*i.e.* they are present wherever the growth of the granulation-tissue is going on. A considerable amount of discussion has taken place with regard to the exact site of the bacilli in the tissues; but it is now generally admitted, as Neisser, Cornil, and Suchard described, that they are for the most part contained within the large globular 'lepra-cells.' In the leprous nodules of the skin, it can be seen that they are present in large numbers in the cells of the infiltration of the dermis and of the subcutaneous tissue, whilst the epithelium is generally quite free from them. So also in the glandular structures of the skin they are generally absent, though they may occasionally be present in the sebaceous glands, in the hair-sheaths, &c. A few may also be found lying free in the lymphatic spaces. The number of bacilli may be enormous, especially in the nodules which are chiefly cellular, each cell in the field of the microscope sometimes containing a considerable number (*see* fig. 85). In all the parts affected by the lesions the bacilli are

[1] See Neisser, *Verhandl. d. Deutsch. Dermatolog. Gesell.* Congress-Burg. 1889, and *Cent. f. Allgem. Path.* 1890, p. 166.

found to be present, and to have a similar relation to the tissue-elements—in the nerves, in the lymphatic glands, in the cornea and other parts of the eye, and in the viscera when affected. As a rule, they are absent from the general circulation, though Cornil and Babes state that they may be present before death, especially if there be fever. When ulcers form on the skin, bacilli may be found in great number in the discharge, and the secretions of mucous surfaces also contain them when these are similarly affected.

Numerous attempts have been made to cultivate the leprosy bacillus, but up to the present without success. Various observers have at different times announced that they have succeeded in obtaining pure cultivations, but their results have not been confirmed. That the leprosy bacillus does not grow outside the body under the same conditions as other known bacilli (*e.g.* of tubercle) seems abundantly proved by the numerous attempts at cultivation. This, however, on the other hand, serves to mark it off more distinctly as a separate species.

Nearly all the attempts to produce the disease in animals by inoculation of material containing the bacilli have completely failed. An exception is, however, afforded by the experiments of Melcher and Orthmann, who in one or two instances, by inoculation of leprous material into the anterior chamber of the eye of rabbits, produced an extensive growth of nodules in the lungs and other organs, which they affirmed contained leprosy bacilli. Though some authorities, who have seen the specimens (*e.g.* Fraenkel), are inclined to believe that the organisms in the nodules are really leprosy and not tubercle bacilli, subsequent experimenters have entirely failed to obtain a similar result. Inoculation experiments have also been made on the human subject, in some cases without result. The most important, perhaps, of these experiments is that by Arning, who, in 1884, inoculated a criminal in the Sandwich Islands who had been sentenced to death. Inoculations were made at several places, and at one a nodular swelling formed, in the juice of which leprosy bacilli were found for more than a year afterwards. Later, in 1887, there developed well-marked tubercular leprosy. The experiment is, however, somewhat invalidated by the fact that before the inoculations the individual had been frequently in contact with lepers.

The absolute proof, therefore, that the bacillus of leprosy is the cause of the disease is still wanting, owing to failure in the attempts to isolate and cultivate it. Yet, if we take the facts established regarding it, together with those of other diseases in which bacilli have been proved to be the causal agents, very little doubt can remain on the subject. The invariable presence of the bacillus in large numbers, its special relation to the tissue-changes, and its absence in all other known pathological conditions, may, in the meantime, be taken as practically conclusive evidence.

11. **Glanders.**—This disease, on account of its resembling tubercle in many particulars, may be conveniently considered here; and although it is of minor importance, on account of its comparative rarity in the human subject, the bacterial nature of the infective virus has been proved with equal completeness, and its properties have been very fully investigated. Only the more important facts can be given. The bacillus of glanders (Rotz-bacillus; *Bacille de la Morve*; *Bacillus mallei*) was discovered by Löffler and Schutz in 1882, the announcement being made shortly after Koch's first publication on the tubercle bacillus. These observers not only demonstrated the presence of the organism in the tissues in glanders, but isolated it, and by inoculation produced the disease in various animals. Babes claims to have observed the same organism at an earlier date (his observations being published in 1881), but he made no cultivations.

This bacillus is of small size, and is generally described as being rather shorter and slightly thicker than the tubercle bacillus. The rods are generally straight, with rounded ends, and when stained often show lighter or unstained spots, some of which at least are generally regarded as being spores; and Rosenthal has succeeded in staining some of them with the carbol-fuchsin solution. In the glanders nodules the rods generally occur singly, scattered, or in little groups, and never form long filaments; they are found both within and outside the cells. In their behaviour to stains they present certain peculiarities, which make their satisfactory staining in the tissues a matter of considerable difficulty. They stain with watery solutions of methyl blue, and other agents, with comparative readiness, though not very deeply (better when an alkali is added), but lose the colour very easily when treated with a decolorising agent. They are accordingly decolorised by Gram's method. The most suitable stain is one which does not readily overstain the tissues, so that little decolorisation is necessary. A great many different methods have been given; the following is one which Löffler has found to be specially suitable: The tissues are stained for five minutes in alkaline methyl-blue solution. They are then placed for five seconds in a decolorising solution—namely, water 10 c.c., to which are added two drops of concentrated solution of sulphurous acid, and one drop of a 5 per cent. solution of oxalic acid. They are then dehydrated in alcohol, cleared in xylol, and mounted in Canada balsam.

The glanders bacillus grows with comparative readiness on nearly all the ordinary

media; but a somewhat high temperature is necessary, 35°-39° C. being most suitable, though growth still proceeds as low as 22° C., and to a small extent even lower. Its growth on potatoes has striking characteristics, which are of aid in the recognition of the organism. First evidence of its growth on potatoes is seen about two days after inoculation, and it spreads on the surface, giving an appearance like a layer of yellow honey. Later, the colour becomes deeper, assuming a brownish tint, which has been compared to cuprous oxide, and it also becomes duller and more opaque in appearance. The characters are well seen about the eighth to the tenth day. (One or two other organisms give a somewhat similar appearance, but these are readily distinguished by their morphological characters.) In stroke-cultivations on agar a whitish line appears on each side of the needle-track, and spreads for a short distance, assuming a yellowish tint with a moist appearance; on blood-serum it appears first in the form of little transparent drops of yellowish tint. In gelatine-peptone it also grows, but the medium of course becomes liquefied at the temperature suitable, and accordingly the growth is not characteristic. In inoculating from glanders nodules, &c., potatoes are found to be the most suitable medium for starting the growth, and they have also the advantage of giving a characteristic appearance.

The bacillus can be dried without being killed, but in the dry condition it retains its vitality for a much shorter period of time than the tubercle bacillus. Löffler found that in most cases the bacilli were dead after being in the dry state for a week, though sometimes they lived much longer. Pure cultivations generally die off after a month. To heat and chemical reagents it offers a comparatively low degree of resistance. It is very rapidly killed by steam at 100° C., and pure cultures are killed by an exposure to 55° C. for ten minutes. Carbolic acid 2–5 per cent., chlorine water, and other agents, are all effective in a few minutes. Accordingly, any of these agents may be employed for disinfecting purposes.

Löffler and Schutz, after demonstrating this organism in the tissues, succeeded in obtaining pure cultivations on the serum of the horse and sheep, and, after growing it through several generations, tested the effects of inoculations on various animals. Some animals they found to be refractory, whilst others were very susceptible. Amongst the latter are field-mice and guinea-pigs. On rabbits the effects are somewhat uncertain; sometimes only a local lesion developing, sometimes a general attack of glanders resulting, with nodules in the lungs, &c. Cats and young dogs are readily susceptible to inoculation, whilst white mice enjoy immunity. Field-mice generally die in about eight days after inoculation, and show an extensive growth of minute nodules in the liver, spleen, &c. Inoculation is rapidly fatal to guinea-pigs also, and they show all the characteristic features of acute glanders. Great interest naturally attaches to its effects upon horses; and Löffler and Schutz, after one doubtful experiment, obtained satisfactory results with two horses. They made several injections at various parts of the body, and at the seats of inoculation boggy swellings formed in a few days, and later many of them broke down into unhealthy-looking ulcers. The lymphatics became swollen so as to form hard cords, and the glands became enlarged to the size of pigeons' eggs and indurated, a discharge took place from the nostrils, and the animals had all the symptoms of an ordinary attack of glanders. One animal died, the other with symptoms of failing health was killed. On *post-mortem* examination both presented lesions characteristic of glanders—not only ulcers on various parts of the surface with implication of the lymphatics in connexion, but also deposits in the nasal mucous membrane, with irregular ulcerations, and nodules in the lungs. Experiments on animals have been repeated by a great number of observers with confirmatory results. The glanders bacillus is one which in cultivations shows great variation in virulence.

The same bacillus is found in the lesions when the disease occurs in the human subject, and cultivations having the same characteristics have been made. Weichselbaum at a comparatively early date (*Wien. med. Woch.* 1885) succeeded in obtaining pure cultivations from the pustules in a case of acute glanders in a woman, and by inoculations on various animals obtained similar results to those of Löffler and Schutz. One of the writers cultivated the bacillus from a farcy bud on the arm in 1880, but failed to produce characteristic effects in animals. Unfortunately, also, workers at this subject have been accidentally inoculated with cultures of this bacillus, with fatal results.

Regarding the presence and characters of this organism, its manner of growth on potatoes, &c., and its effects on animals, there is practical unanimity amongst all who have investigated the subject. The results of the experiments of Bouchard, Capitan, and Charrin about the same time as those of Löffler and Schutz are now generally regarded as fallacious. These observers found in the glanders nodules, &c., organisms in the form of cocci, often growing in chains, which they were able to cultivate through several generations, and by means of which they produced the disease. Probably there were also glanders bacilli present in the cultivations in small quantities, and to them the results were due.

In its mode of action and in its effect upon

the tissues, this organism presents a certain resemblance to the tubercle bacillus. Its growth may remain for a long time local, or it may rapidly produce a general infection; but in all situations its action on the tissues is the same. By its growth it causes irritation, which produces cell proliferation and leucocyte infiltration, so that a small focus or nodule results, which may enlarge to various dimensions. If at any place the bacilli are present in large numbers (*e.g.* after a local inoculation), the area which shows the reaction is correspondingly large. Along the lines of the lymphatic vessels and in the lymphatic glands a similar action takes place, giving rise to the well-known thickening and induration. The nodules in glanders, owing doubtless to the nature of the chemical products of the organism, have a great tendency to undergo softening and to break down. Hence the formation of ulcers in various parts which is so important a feature in glanders. The action of the organism is for the most part confined to the lymphatic system; but that it also enters the blood, and is thus distributed, is proved both from the anatomical disposition of the lesions and also by the actual demonstration of its presence in, and its cultivation from, the blood, though in most cases this is a matter of great difficulty. The bacilli are found in greatest numbers in the small nodules of recent formation. In old nodules, especially when ulceration has taken place, their detection is a matter of great difficulty, or may be quite impossible.

The spread of the disease takes place for the most part by direct inoculation of material containing the bacilli—nasal secretion from a case of glanders, &c.—on a wound of the skin or on a mucous membrane. In horses and asses, at least, the disease is probably also transmitted by inhalation of the organisms suspended in the air. That this is not a rare occurrence is likely from the fact that the lungs may contain numerous nodules without evidence of the disease in any other part of the body. Babes (*Arch. d. Méd. Expér.* 1891, iii.) found that the disease could readily be set up in susceptible animals by exposing them to an atmosphere in which cultures of the organism had been pulverised. He also found that inunction of the skin with vaseline containing the bacilli might produce the disease, their entrance being in this case along the hair-follicles. As a means of diagnosis in doubtful cases of the disease, as has frequently been pointed out, the method of inoculation is of much greater service than microscopical examination; and for this purpose guinea-pigs are the most suitable of the animals generally available. Strauss states that after inoculating the peritoneal cavity of a male guinea-pig with glanders secretion, a swelling of the testicles rapidly takes place, and the growth of small nodules can be found in the tunica vaginalis as early as two days after the inoculation. Within recent years a substance ('*mallein*') has been introduced, which is said to afford a certain means of diagnosis. It was prepared by Kalming as a watery extract, and by Preusse as a glycerine extract, of cultures of the glanders bacillus. This substance when injected in certain doses is said to produce a febrile reaction in glandered animals, but none in others. The method is still under trial.

A. Babes (*Arch. de Méd. Expér.* July 1892) has isolated a substance which he calls '*morveine*,' and which from its chemical characters he thinks to be of the nature of an enzyme. He prepares it by precipitating filtered cultures of the bacillus with equal parts of alcohol and ether, and finds it to be exceedingly powerful in its action, and that it causes a reaction especially in glandered horses. He also states that he has been able to produce by repeated small injections of it an immunity against glanders, and in one case of the disease he succeeded in effecting a cure. All these statements still require confirmation.

12. **Actinomycosis.**—*See* special article.

13. **Rhinoscleroma.**—This disease, which is characterised by a chronic induration and thickening of the skin and of the mucous membranes of the nose, pharynx, and other adjacent parts, has the features of a chronic inflammatory process produced by a specific irritant, and this is probably a bacillus. The presence of organisms in the affected tissues was first observed by Frisch in 1882 (*Wien. med. Woch.*), and his observations have been confirmed. In fact, there is practical agreement amongst those who have had an opportunity of studying the disease, regarding the invariable presence of a bacillus with definite characters. This organism is very similar in form to the 'pneumococcus' of Friedländer, occurring in the form of short rods, often several in a row, which are surrounded by a hyaline capsule. They generally measure 1·5–3 μ in length, and about ·7 μ in thickness. As described by Cornil, Alvarez, Payne, and others, they are found, often in considerable numbers, within the large spherical cells which are present in large numbers in the thickened dermis, and also lying free in the connective-tissue spaces and in the dilated lymphatics. The rods are readily coloured by Gram's method, and the capsules may thereafter be stained red by safranin. Cultivations of the organism have been made, first by Paltauf and v. Eiselsberg in 1886, and since then by many others. On peptone-gelatine the growth has a remarkable similarity to Friedländer's pneumococcus, being in the form of a rounded knob on the surface, with a thin line along the

needle-track. The only difference observed is that it is rather more yellowish in tint, and more opaque in appearance. The rods also tend to be of greater length, and, as already stated, they differ in staining with Gram's method.

Organisms have, however, been found in other situations by various observers, which in their characters are said to be similar to the bacillus of rhinoscleroma, and some of them have been cultivated from healthy nasal secretion; and it has been held that in rhinoscleroma some of these organisms have simply passed into the tissue already diseased. Yet the invariable presence of the organism, and its special relation to the tissue-changes, are strongly in favour of its standing in causal relationship to the disease.

Unfortunately, experiments on animals are not conclusive, and different results have been obtained by different observers. Paltauf and v. Eiselsberg failed to produce any change like rhinoscleroma; whilst Pawlowsky, by injections into the anterior chamber of the eye, produced a chronic inflammatory overgrowth with large epithelioid cells, some of which contained hyaline globules such as are found in rhinoscleroma. From what we know of other diseases, it is scarcely likely that a true rhinoscleroma can be produced in animals.

Bandler has found the same organism in a chronic inflammatory thickening of the vocal cords—*chorditis vocalis inferior hypertrophica*—and has made pure cultivations from the diseased tissue; and accordingly believes that the affection is the same as rhinoscleroma.

14. **Syphilis.**—Although many observations had been made on this disease, with a view to finding characteristic micro-organisms, and such had been described by various observers at an earlier date, the work which is probably of most importance, and which has certainly attracted most attention, is that of Lustgarten, who in 1884 announced the discovery of a bacillus with special properties. He found in the affected tissues thin bacilli, generally 3·5 to 4·5 μ in length, often bent or slightly irregular, with small swellings at the extremities, and sometimes showing two to four spores in their interior. They occurred chiefly within the larger cells, especially at the periphery of the syphilitic infiltration, though some were also found lying free in the lymphatic spaces. He was able to demonstrate these organisms in all of sixteen cases which he examined, using a special method as follows: The sections were stained for twenty-four to forty-eight hours in an aniline-water solution of gentian violet; and after being washed in alcohol, were placed for ten seconds in a 1·5 per cent. solution of permanganate of potassium. They were then treated with sulphurous acid, which removes the brown precipitate which has formed and decolorises the sections; washed in water; dehydrated, and mounted. Tubercle and leprosy bacilli can be coloured in the same way; but, unlike these, the 'syphilis bacilli' are easily decolorised by mineral acids. Subsequent observations would appear to show that these organisms are not always present in the syphilitic lesions, and several competent observers have altogether failed to find them. Moreover, it has been asserted that a similar organism may be normally present on the surface of the genital organs (the *smegma bacillus* of Alvarez and Tafel), and that in syphilis it enters the affected tissues secondarily. This, however, would not explain its presence in the lesions in the internal organs in syphilis. Since the publication of Lustgarten's work, other organisms, supposed to be characteristic, have been described by various observers as being present in the tissues, and even in the blood, in syphilis. The whole question is at present in a very doubtful state, and we cannot say that any particular organism is even probably the cause of the disease.

GROUP IV.—*Diseases associated with Spirilla.*

15. **Cholera, Asiatic.**—Although many attempts had been made to discover the cause of cholera, and various fungoid and allied organisms had been found in the discharges, and had been supposed to be the specific agent, none had any sufficient scientific support until the discoveries of Koch in 1884. But it cannot be doubted that antecedent observations, erroneous though they may have been, paved the way for the acceptance of the view that cholera may be due to a micro-organism.

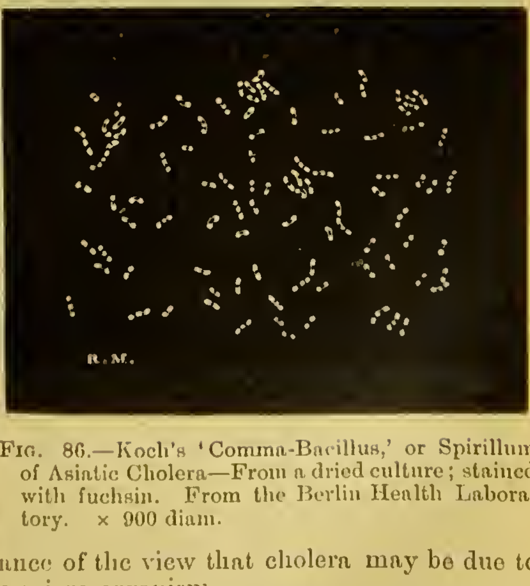

FIG. 86.—Koch's 'Comma-Bacillus,' or Spirillum of Asiatic Cholera—From a dried culture; stained with fuchsin. From the Berlin Health Laboratory. × 900 diam.

It might be well to state at the outset that, although the observations of Koch may be regarded as practically beyond dispute, and

although the organism discovered by him affords in its reactions a striking explanation of many of the phenomena of cholera, yet we lack absolute scientific proof of its causal relation to the disease. Enough is known, however, to make its provisional inclusion justifiable. Moreover, Koch's results have been confirmed by the vast majority of competent observers in all parts of the world.

The 'comma bacillus' of Koch, or 'Spirillum choleræ Asiaticæ,' is a very minute organism, each cell being about 1·5 to 2 μ in length, and ·5 to ·6 μ in thickness, curved in varying degree, and therefore resembling a comma. Each cell is flagellated at one or both ends, commonly only at one end, the flagella being either single or double, from one to five times the length of the cell, and not more than ·05 μ in thickness. As in other spirilla, the flagella may be present only at some periods of life; and we may find the cells when they are grown under various conditions, in pairs, S-shaped, or in longer filaments of corkscrew form, and even as straight rods. (This will be best understood from a comparison with the drawing of spirillum undula, fig. 69.)

The cells are actively motile, especially in warm temperatures. When stained, the individual cells may show darker parts at the ends or centre, suggesting possible spore-formation. But although much attention has been devoted to this question, no spores have yet been proved to exist.

The microscopical characters are seen in the accompanying figures, one of which (fig. 86) is drawn from a specimen stained with fuchsin, the other (fig. 87) from one stained by Löffler's method for showing flagella.

Fig. 87.—Finkler's Spirillum and Koch's Cholera Spirillum, both prepared in the same manner, stained by Löffler's method, to show flagella; and placed side by side for comparison.—*a*. Finkler's Spirillum. From a culture made in the Pathological Laboratory, Univ. Edin. *b*. Koch's Cholera Spirillum. From a specimen from the Berlin Health Laboratory. × 2,000 diam.

Side by side with the latter is a drawing from a cultivation of Finkler's comma bacillus, stained by the same method. The relations of Finkler's bacillus or spirillum will be subsequently referred to.

To stain the spirillum, after drying the intestinal contents on a cover-slip, a watery solution of fuchsin may be used, best with heating for about ten minutes. But Löffler's method gives far better results, though it is much more tedious and uncertain. Specimens stained in this way usually appear larger than when simply stained. For partial staining, a very dilute solution of methyl violet may be mixed with the intestinal contents on the slide.

Sections of the intestine may be stained for twenty-four hours in fuchsin or alkaline methylene-blue solution.

Growth and Cultivation of the Spirillum. These organisms grow best in alkaline media, and with free access of oxygen; indeed, it is said that some of the movements appear to be actively directed to the search for oxygen when a 'hanging drop' is studied. But they must be capable of growth with a deficient supply of free oxygen, as in the intestine, deriving it from the blood and lymph, or from compounds which contain it.

The presence of acids is generally prejudicial to their growth, yet they grow on potatoes of which the reaction is slightly acid.

For active growth a temperature of 30° to 40° C. (85° to 104° F.) is best suited, and growth is arrested below 15° C. or above 42° C. Growth also ceases in an atmosphere of H or CO_2, but revives on readmission of oxygen. A temperature of – 10° C., or vacuum, does not destroy the spirilla; but drying for two to three hours, or a temperature over 50° C., soon kills them. They grow readily in meat-broth, even when exceedingly dilute, in milk—producing little or no perceptible change in it, on blood-serum, nutrient gelatine or agar, and on potatoes.

The growth on nutrient gelatine and on potatoes is especially employed for diagnostic purposes.

In gelatine-plate-cultivations, made in the manner already described, minute whitish points appear, and around them the gelatine liquefies, the minute colony, not larger than 1 mm. in diameter, sinking into a funnel-shaped depression. By the end of the second or third day (if the plate is kept at about 20° C.) it is covered with these small funnel- or bubble-shaped depressions. The liquefaction spreads peripherally, and the entire surface becomes liquefied, the rapidity of course depending on the number of points of growth.

The appearances on examining the plate microscopically in the usual way, with a low power, are also peculiar. The individual colonies are very irregular in shape, and as they enlarge they appear highly granular, resembling, as Koch remarked, a mass of particles of ground glass, and having a peculiar glistening appearance, the colour being white or faintly yellowish. As lique-

faction occurs, a clearer zone, with crenated edges, surrounds the colony, and later the mass sinks into the funnel-shaped hollow caused by the liquefaction. At this period a faint roseate hue may sometimes be observed in the colony, which is regarded as absolutely peculiar to the cholera spirillum, and has not been observed in any other similar growth.

If grown in such a way that higher powers can be used for observation, each droplet is found to swarm with actively moving spirilla.

The mode of growth in puncture-cultivations in nutrient gelatine is also peculiar. The growth along the needle-track is most active near the surface, and as liquefaction occurs the colony grown at the surface sinks into the jelly. The funnel-shaped area of liquefaction enlarges beneath the surface, and thus acquires a bubble-like appearance. Later, the liquefaction advances more deeply along the needle-track, and an elongated funnel- or finger-shaped zone of liquefaction occurs. This spreads until it reaches the sides of the tube, and from this time spreads deeper in the tube. But the process of liquefaction is slow, and with jelly of sufficient strength (10 to 15 per cent. gelatine) may take some weeks. At the bottom of the liquefied area are whitish masses of spirilla, whilst at the surface is a scum or pellicle of them, mostly in various stages of degeneration.

The cultivations thus made are liable to rapid degeneration and death, so that after five or six weeks it may be difficult to make secondary cultivations from them.

On agar jelly, the surface-growth is in moist-looking, whitish streaks, which do not tend to spread much, and are not specially characteristic. When older, the cultivations tend to become of brownish colour. The agar is not liquefied. The duration of life in agar-cultivations is much greater than in nutrient gelatine, successful recultivations having been made after some months.

On potatoes, especially when kept at a temperature of 20°–30° C., the growth spreads as a thin translucent layer of somewhat brownish-yellow or greyish-brown colour, the exact shade probably depending on the different kinds of potato or the temperature and moisture.

In broth the growth is rapid, and the spirilla tend to accumulate in a scum upon the surface, some masses falling to the bottom, leaving the greater part of the broth clear.

The methods of cultivation thus described are of practical importance, since the characters presented by the cultures are, when taken together, almost peculiar to the cholera spirillum. It is true that some closely allied forms, *e.g.* Finkler's spirillum, which has been found in cases of summer diarrhœa in the intestinal evacuations, and perhaps some others, give reactions which are very similar. But the liquefaction of the jelly is more rapid, and does not in tubes assume the same peculiar form. If the cultivations are studied side by side, one can easily see these differences, but they are not to be readily perceived by those who have not carefully worked with the true cholera spirillum. As may be seen from fig. 87, the differences in the microscopic characters of the two would not be readily perceptible.

Hence the importance of discovering some further diagnostic characters. One which has been suggested is found in the fact that, if a cultivation in peptonised broth is treated with dilute sulphuric acid, which must be absolutely pure, a reddish violet or even purple colour is produced. This reaction, which is said also to occur with the so-called vibrio-Metchnikoff, but not with Finkler's spirillum, is stated by Salkowski to be due to the presence of indol. It is therefore only reliable if extreme care is taken to prevent the formation of indol in other ways by reduction, and to use only pure sulphuric acid. And it is best to cultivate in extremely dilute broth.

But, by the careful study of the various modes of growth and reactions, the practised observer can distinguish with almost absolute certainty the 'comma bacillus' of Koch; and important practical results in the early detection of cases of cholera have been attained in this way.

The study of this organism leaves no doubt that it is capable, under favourable conditions, of propagating itself outside the human body, or, as some would put it, that it has a saprophytic *rôle* in nature. The favourable conditions can only be attained where there are a suitable temperature and site and soil for its continuous propagation. Experiment has shown that it can live in pure water for some time, but that in water containing organic matter and other bacteria it is said to flourish only a short time, and is then killed by the growth of the other bacteria. In what way it succeeds in persisting in localities where the disease is endemic, as in the delta of the Ganges, and along the Yang-tze-Kiang valley, is not yet fully explained. Some recent observations throw doubt upon its absolute incapacity to withstand drying, and suggest also that, whilst it is readily destroyed by drying when grown in the intestinal canal, it has a greater degree of vitality in conditions of free growth outside the body. Nor can we overlook the fact that many bacteria, which are readily suppressed by others when grown with them in artificial cultivations, do not entirely perish, but some frequently survive, and may be recultivated, though with difficulty.

Relations to the disease.—Briefly stated, this peculiar bacterium was found by Koch in the intestinal discharges and contents in all cases of true Asiatic cholera, reaching the maximum degree of abundance at the height

of the disease, and then almost entirely replacing the common bacteria of the intestinal canal. On the other hand, it was not found in the excreta of healthy persons, or under any other conditions than where cholera was present, disappearing with the epidemic. This constant association with the disease has been confirmed by many observers in different parts of the world. Moreover, the conditions under which cholera occurs and disappears correspond with what might be expected from our knowledge of the life-history of the spirillum. For details on these points other works must be consulted.

The organism is not only found especially in the intestine and its contents, but is practically limited to them, not invading either the blood or other organs. In the intestine it penetrates into the crypts of Lieberkühn, and may be found beneath the epithelium, but rarely makes its way more deeply. The intestinal contents, especially when examined immediately after death in rapidly fatal cases, resemble cultivations of the spirillum.

Attempts to produce the disease in lower animals by inoculating or injecting the organism are open to the difficulty that cholera never affects the lower animals. But since in other diseases peculiar to man success has been attained by inoculation of the cultivated specific organisms, this barrier is not necessarily insuperable.

After numerous experiments by various observers, many of them of doubtful value, the result has been attained by Koch and confirmed by others, notably by Macleod and Woodhead, that, if the contents of the alimentary canal in guinea-pigs are rendered alkaline, and the peristaltic movements partially arrested by means of opium or in other ways, the injection of cultivations of cholera spirillum into the stomach is followed by a condition closely resembling cholera. Diarrhœa is absent, but the intestines are found after death to be distended with fluid containing enormous quantities of the organism, and the changes in the structure of the intestine resemble those in human cholera.

An unintentional experiment on the human subject is also recorded by C. Fraenkel.[1] A doctor, working in the 'cholera course' in Koch's laboratory, and in no other way exposed to the disease, had a severe attack of typical cholera, with the usual presence of the 'comma bacillus' in the stools.

Mode of action in the disease.—We have seen that the spirilla are positively limited to the intestines within the human body, and that they do not even here penetrate more deeply than just beneath the epithelium. Careful research has failed to discover them in the blood or any of the other organs. Their action would therefore appear to be entirely local, and to produce an intense and peculiar irritation of the intestinal mucous membrane, which constitutes the chief *post-mortem* appearance. How far the other symptoms of cholera are explained by this intestinal lesion, and by the rapid withdrawal of water, has been disputed. That they may be due to these alone is suggested by the phenomena of some other poisons which cause severe diarrhœa. But it is probable that there is in addition some poison produced in the bowel, which is absorbed into the blood.

Various attempts have been made to isolate this poison, but of the numerous substances which have been separated from cultivations it is at present uncertain whether any one of them is the special cholera toxine or tox-albumen.

The general facts as to the spread of cholera, its conveyance mainly or solely through the excreta, its rapid development and spread by infected water or milk supply, its relations to temperature, and so on, accord very closely with what has been discovered with regard to the 'comma bacillus.' And whilst there are some points which need explanation, the researches of Koch may safely be followed as practically true for the treatment of epidemics, with the sole exception of a doubt whether drying is a sufficient means of disinfection.

Reference has been made to Finkler and Prior's comma bacillus, and to the vibrio of Metchnikoff. These organisms, and some others which have been carefully studied, *e.g.* Deneke's comma bacillus and Emmerich's bacillus, have in some ways close resemblances to Koch's spirillum, and much has been said and written about them. It is at present questionable whether any of them can be regarded as the specific agents of any disease. The alleged results of their cultivation and inoculation in animals have not been sufficiently confirmed to make it worth while here to detail them. All that may be said is that, whilst unquestionably there are other species of spirilla found in nature, and even in the human body, which bear a close resemblance to the 'cholera spirillum' of Koch, they show, when carefully investigated, marked differences in their conditions of life, mode of growth, and still more in their peculiar relations to disease. Their study has tended to confirm the view that Koch's organism has, amongst the closely allied minute spirilla, a peculiar and special relation to cholera.

Within recent years several methods of producing immunity against the effects of the cholera spirillum have been announced. Of these probably most importance attaches to that of Haffkine, who states that he has produced immunity even against the virus in intensified form. This *virus exalté* is produced by growing the organism in the peritoneal cavities of a series of guinea-pigs in succession—generally about twenty—when

[1] *Grundriss der Bakterienkunde*, 3rd edit. p. 365.

it is found that it has acquired a greatly increased degree of virulence, and is rapidly fatal to guinea-pigs if injected into the blood or alimentary canal. Subcutaneous injection, however, causes merely a local necrosis; but if the animal has previously been injected by an attenuated form of the virus—the attenuated form being produced by growing in a current of air—the necrosis does not occur, but merely a local œdema. (The entire method of attenuation is merely an exact repetition of the mode adopted by Pasteur in his well-known researches on 'fowl-cholera,' a form of septicæmia which has no relation to Asiatic cholera.) After the animals have been thus treated by subcutaneous injection, first with the attenuated virus, and then with the *virus exalté*, they are found to be quite immune against the organism introduced in any way whatever. Haffkine inoculated Hankin and several others by this method, and, so far as the local changes are concerned, produced the same effects as in guinea-pigs, *i.e.* after injecting with the attenuated virus he injected with the intensified form, with no further result than a local œdema and some fever. It thus appears that the human subject may be inoculated with safety by this method, and it remains to be seen whether any immunity is conferred against the natural disease, and, if so, how long it lasts. Of other methods of conferring immunity which have been described, space does not permit us to give an account.

16. **Relapsing Fever.**—At a time when practically nothing was known regarding the part played by bacteria in the causation of disease, a spirillum was discovered in the blood of patients suffering from relapsing fever, and found to have a definite relation to the phenomena of the disease. This organism was discovered by Obermeier in 1873 (*Centralb. f. med. Wis.* 1873, p. 145), and is generally known as the *Spirillum* or *Spirochæte Obermeieri*. He found it in the blood of patients suffering from this disease during the time of the fever, but observed that it began to disappear shortly before the crisis, and that after the crisis it was absent; also he failed to find it in any other condition. In every respect his observations have been confirmed.

Description of the organism.—The spirillum is of considerable length, measuring '1½ to 6 times the diameter of a red blood-corpuscle,' but is exceedingly thin. It shows several regular somewhat abrupt curves, and is of uniform thickness, except at the extremities, where it is pointed. It is possessed of very active motility, having both a wavy and spiral motion, and being also capable of rapid locomotion. At the onset of and during the fever the spirilla may be present in the blood in enormous numbers. The organisms always occur free, being never found either within the red corpuscles or the leucocytes. In dried films of blood they can be stained by any of the simple stains, though they do not take the colour very deeply; but in sections of the tissues their demonstration is a matter of considerable difficulty, and one of the methods for avoiding decolorisation requires to be used, methyl blue being a suitable dye. They are decolorised by Gram's method. Koch succeeded in staining in the tissues with Bismarck brown.

In blood outside the body the spirillum has considerable vitality, sometimes showing active movements after several days. It is killed by a temperature of 60° C., but it can be exposed to 0° C. without being killed.

Relations to the disease.—All attempts to cultivate the organism outside the body have hitherto failed. Koch observed that in certain conditions a growth of the organism in length took place, but no actual multiplication. Soon after its discovery, however, Münch, by injecting blood containing the organism, produced the disease in the human subject (*Centralb. f. med. Wis.* 1876); and a little later Vandyke Carter and Koch produced the disease in apes by a similar procedure. In such cases there is an incubation-period usually of three to six days before symptoms appear. In all cases, along with the onset of the fever, the spirilla appear in the blood in enormous numbers. As a result of these observations and experiments it may be considered as practically proved, even in the absence of pure cultivations outside the body, that this organism is the cause of the disease.

As already mentioned, the organisms disappear from the blood about the time of the crisis, and are absent during the 'interval.' Metchnikoff (Virchow's *Archiv.* 1887, Bd. 109, p. 175), by producing the disease in apes and killing them at various stages of the fever, found that during the period of defervescence the spirilla on disappearing from the blood accumulated in the spleen, and alleged that they were incorporated within leucocytes in that organ. Within these cells he observed spirilla in various stages of disintegration. This process of 'phagocytosis' never occurs, according to him, in the blood, and after the spirilla have disappeared from the blood they are not present in any other organ than the spleen. Soudakewitch (*Ann. de l'Inst. Past.* 1891) has performed similar experiments, and obtained practically the same results. It is, however, still unexplained why the disappearance of the organisms from the blood should start at a particular time, and should then take place so rapidly.

It is not known whether spores are formed or not, nor where and in what condition the organism exists in the body between the attacks of the fever. As to possible existence and life-history outside the human body we are still in ignorance.

GROUP V.—Not coming into any of the previous classes.

17. **Anthrax.**—The Bacillus anthracis is one of the best known and most fully investigated of all pathogenic bacteria, and was the first to be conclusively proved to be the cause of a definite disease in man, and in some of the lower animals. It was first observed in the blood of animals affected with the disease by Pollender in 1849, and was afterwards the subject of important investigations by Delafond, Davaine, Brauell, Koch, and later by Pasteur. By the experiments of these workers its causal relation to the disease had been almost conclusively proved, but the final proof was given by Koch in 1876. He was the first to succeed in obtaining pure cultivations of the bacillus outside the body, and was thus able to test the effects of its inoculation on animals without risk of fallacy. Owing to its comparatively large size, this organism has been the subject of much study, which has yielded valuable information on the morphology of bacteria, the origin and mode of formation of spores, as well as their vital properties and powers of resistance. Furthermore, discoveries regarding modification of its virulence, and the possibility of preventive inoculation, have proved of great value in relation to the whole subject of acquired immunity, and have been of much practical utility. It also serves as an excellent example of a micro-organism causing rapidly fatal results by its multiplication in the blood throughout the body.

The Bacillus anthracis (*bactéridie du charbon*; *Milzbrandbacillus*), as seen in the blood of an animal affected with the disease, occurs in the form of comparatively large rods, whose thickness is about 1·5 μ, and whose length is generally about the diameter of a

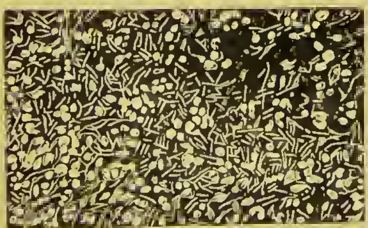

FIG. 88.—Part of the Spleen of a Guinea-pig which died of anthrax, showing the relative proportion of bacilli and leucocytes. × 100 diam. From a photomicrograph.

red corpuscle, though both shorter and much longer forms are seen. The rods may be present in enormous numbers, sometimes appearing to equal the red corpuscles in number. In the blood and in the spleen the rods occur singly, or two or three may be joined end to end, but long chains are not usually found. In the pleural exudate and in similar fluids, as well as in cultivations outside the body, the organism grows into long filaments, which may be shown to be made up of a large number of individual bacilli. The rods have slightly rounded or nearly square extremities, and their protoplasm has a homogeneous or slightly granular appearance, but spores are not usually found in the bacilli within the living body. When the organism is grown outside the body in a suitable soil, at a sufficiently high temperature (not below 18° C.) and in the presence of oxygen, spore-formation occurs, which in its chief features agrees with what has previously been described under 'Spore-formation.' The various appearances are well seen in the accompanying woodcut (fig. 89).

FIG. 89.—Bacillus Anthracis in a Blood-vessel in the Heart of a Cow. × 950 diam.

Cultivation, &c.—The anthrax bacillus can readily be cultivated outside the body on all the ordinary media. It grows at ordinary temperatures, but much better about 35° C., the limits of growth being generally given at 12–45° C. On certain media its growth has a characteristic appearance.

In puncture-cultivations in peptone-gelatine the growth appears along the needle-track as a somewhat whitish line from which fine lateral offshoots spread out horizontally in the medium, these also in their turn giving off lines of growth, so as to produce an appearance which has been compared to bunches of fine bristles. The lateral stems are longest near the surface of the gelatine. Later, liquefaction begins at the surface and spreads downwards, so that the characteristic features are lost, and the growth appears as a white flocculent mass at the junction of the fluid and solid portions. In plate-cultivations minute white colonies appear, which, on reaching the surface of the gelatine, cause a little area of liquefaction around them. If these superficial colonies are examined with a low-power lens, the periphery is found to have an appearance like masses of curly locks of hair, the centre of the colony being denser and of a slightly greenish tint. The

appearance is due to the growth of the organism in wavy bundles of long parallel filaments, which in the centre of the colony are interwoven and massed together. On potatoes the growth is abundant, and appears as a thick cream-like mass, which remains chiefly localised and has little tendency to spread on the surface. The growth on other media presents nothing characteristic. The bacillus also flourishes well in broth and other liquid media.

Growth takes place only in the presence of oxygen, and best on a neutral or slightly alkaline medium. In all conditions the bacilli are found to be devoid of the power of independent movement. They can be coloured readily by Gram's method, and by the various simple aniline stains.

Anthrax bacilli in the spore-free condition have comparatively little resisting power to chemical antiseptics, &c. When dried they are generally found to be dead after a few days, and they soon die in fluids in the presence of putrefactive bacteria. They are very rapidly killed by moist heat at 65° C., and by a 1 per cent. solution of carbolic acid; the action of the gastric juice is also rapidly fatal to them, and they are therefore generally killed in their passage through the stomachs of animals. The spores, on the other hand, show a remarkable tenacity of life, regarding which some of the chief facts have already been given. As is well known, they can be kept in the dry state for an almost indefinite period of time, and still be capable of growth when placed in suitable conditions. Dry heat at 140° C. must be applied for several hours in order to kill the spores with certainty, and they may be placed in a 5 per cent. solution of carbolic acid for a considerable time without being killed. Unlike the bacilli in the spore-free condition, they can pass through the stomach unaltered, and thus reach the intestine in a virulent condition. The facts stated with regard to the conditions of formation of spores, and their powers of resistance, are of the greatest importance in relation to the life-history of the organism, and the mode of spread of the disease.

Relations to the disease.—When inoculated into susceptible animals (such as mice, rabbits, guinea-pigs, &c.) even in the minutest quantities, this organism causes a rapidly fatal disease. The bacilli generally soon reach the blood, and rapidly multiply, so that they may be present in enormous numbers; in the spleen also they are very numerous in some animals, and this organ in most animals shows marked enlargement. Death generally takes place in one or two days. The other *post-mortem* changes are chiefly those of a severe septicæmia—congestion and cloudy swelling of organs, and often small hæmorrhages, which are in many cases associated with plugging of the capillaries with small masses of the bacilli. At the seat of inoculation there may be inflammatory œdema, with extravasation of blood; or there may be little change. In sections of the tissues the bacilli are found in enormous numbers in the capillaries (in comparatively small numbers in the larger vessels); in fact, so numerous are they in the capillaries of the kidneys, liver, intestines, peritoneum, and lungs, that in stained specimens these may appear as if injected with a coloured material. Animals may be infected by inhalation either of the bacilli or their spores, the former generally producing a pneumonic condition, whereas the latter may be rapidly absorbed, and produce a general infection with comparatively little local change. Infection by the spores may also take place by the intestinal tract, and this is probably the common mode in the natural disease in sheep and cattle. The modes of infection in the human subject, and the lesions produced, are described under PUSTULE, MALIGNANT. Certain animals enjoy a natural immunity against the action of the anthrax bacillus, for example, adult dogs, white rats, many birds, and frogs; though the susceptibility may be modified by altered conditions of temperature.

In view of the enormous numbers of bacilli which may be present in the blood, it was formerly thought that their effects were produced partly mechanically, and partly by their using up the oxygen of the blood. And though they do act in both of these ways, it is now known that, in common with other pathogenic bacteria, the anthrax bacilli produce specific chemical poisons. A so-called toxalbumen was separated by Brieger and Fraenkel, whilst Sidney Martin has separated albumoses and a poisonous alkaloid. Sidney Martin finds that the action of the bacillus on the proteids of the body is very similar to that of the tryptic ferment, an alkaloid being one of the products of the breaking up of the peptones. This alkaloid is a local irritant, producing inflammatory œdema, and it also causes fever, whilst the albumoses produce coma in animals. He was able to separate these substances both from anthrax cultures, and from the blood and spleen of animals which had died of the disease. Hankin also isolated an albumose which was fatal to guinea-pigs and mice in very minute doses.

So numerous and various are the experiments on the subject of the production of artificial immunity against anthrax, that only one or two of the most important results can be stated. In the various methods employed there are two chief principles involved—first, that one attack of the disease protects from subsequent attacks for a considerable period of time; and, secondly, that the virulence of the organism may be so modified by the conditions of its growth, &c., that when

inoculated it produces a much milder form of the disease, but one which is still capable of producing immunity for a time. At the outset, to correct a common misconception on this subject, it may be definitely stated that the earliest successful results were obtained by English workers. Duguid and Burdon-Sanderson found that if bovine animals were directly inoculated from guinea-pigs suffering from anthrax, the disease produced was not a fatal one. Greenfield confirmed this discovery, and also found that the bacilli obtained from guinea-pigs retained their properties in cultivations, and could therefore be used as a protective vaccine for cattle. He also found that when grown through successive generations in aqueous humour, their virulence became greatly attenuated. These facts were published before the work of the French observers. Toussaint very shortly afterwards stated that if the blood taken from an affected animal and containing the bacilli were exposed to a temperature of 55° C. for a certain time, it acted as a protective agent when injected into animals. Pasteur somewhat later published his method of attenuation and preventive inoculation, regarding which the following are his chief statements. Anthrax bacilli grown at 42·5° C. do not form spores, and after twenty-four days are so modified that they do not kill rabbits or sheep, though they are still fatal to mice. A cultivation thus prepared is employed as the *premier vaccin*. Cultivations kept under the same conditions for twelve days have their virulence less diminished, and constitute the *deuxième vaccin*. Sheep injected with the *premier vaccin*, and fifteen days later with the *deuxième vaccin*, enjoy an immunity against the most virulent cultures. Pasteur's results have been utilised in France and elsewhere for the protection of cattle and sheep, apparently with success, but great care is requisite in the preparation of the vaccine in order to obtain safe and effective inoculation. The immunity produced in this way is not permanent. Pasteur's method has been criticised by Koch and other German workers. These have acknowledged the efficacy of the method as a means of conferring immunity, but have called in question its applicability as a means of general vaccination against the disease. Other methods of modifying the virulence of the anthrax bacillus have been discovered; for example, Chamberland and Roux found that this was effected by adding a small quantity of carbolic acid to the medium (1 to 600), and Chauveau obtained a similar result by growing it in compressed air.

Recently Hankin has found that the albumose which he has separated from cultures of the bacillus, when injected in very small quantities, is capable of producing immunity, even in mice, which are the most susceptible of the animals commonly used. In the case of anthrax, therefore, one of the poisonous products of the bacillus acts as the protecting agent against subsequent attacks. It is also interesting to note that he found that the bacilli of the *premier vaccin* produce much less albumose than is found in virulent cultures, and therefore Pasteur's method would appear to be a gradual acclimatising of the organism to the albumose poison. The soluble products of a micro-organism had in several instances been proved to be capable of conferring immunity against its action, but this is the first case in which a definite chemical substance possessing this property has been isolated. R. M.

18. **Diphtheria.**—The presence of bacteria and other organisms of various kinds in the false membranes in diphtheria has long been recognised. Within a comparatively recent period the most careful research had only established the almost constant presence of micrococci, masses of which can be readily observed, not only in the false membranes, but also in the deeper tissues, in the swollen lymphatic glands of the neck, in the kidneys, and sometimes in other organs. Their constancy and association with the parts most especially attacked by the disease were strong arguments in favour of their specific relation.

But further research has shown that, although almost constantly present, the micrococci cannot be regarded as the peculiar and specific agent of the diphtheritic virus, but only as associated with, and possibly concerned in, some of the secondary phenomena. The true agent of diphtheritic infection is almost conclusively proved to be the diphtheria bacillus. Klebs had described and studied bacilli of special characters in the false membranes in 1875, but the most complete description of the bacillus and working out of the subject are due to Löffler. Hence the bacillus is commonly known as Löffler's diphtheria bacillus, or less commonly as the Klebs-Löffler bacillus. Löffler's original observations (*Mitth. aus d. K. Gesundh.*, 1884) have been in the main confirmed and largely extended by many subsequent observers. Some of them are referred to below. Of the highly interesting and important observations only a brief summary of the best-established facts can here be given. The bacillus is constantly present, not only in epidemic, but also in sporadic diphtheria, and in membranous croup. The proportion of cases in which it has been discovered microscopically, cultivated, studied by inoculation, &c., by every observer who has investigated any series of cases, is so large that the exceptions are readily accounted for by accidental conditions or defects in method. Speaking generally, its special habitat is in the false membranes; and it produces the peculiar toxic phenomena by means of a poison which

is there generated and absorbed into the system.

At first the bacilli are found in small numbers upon and in the superficial layers of the epithelium of the mucous membrane, especially where excoriated; and as the false membrane is formed they multiply, especially in its older and therefore more superficial parts. (That the part in which it is found may not *always* be actually the most superficial is due to the fact that in some positions layers of fibrinous exudation may be superposed at a later period, though this is not the common mode of occurrence. A detailed account of the various modes of formation of the false membrane would here be out of place.) Where the epithelium has been entirely detached, some bacilli may be found penetrating it, especially in those parts infiltrated with serum or sero-fibrinous exudation. But, with rare exceptions, they do not appear to penetrate more deeply, or to become diffused throughout the organism.

In those parts where the diphtheria bacilli are found they may be scattered, or in lines or patches, or, not uncommonly, in spheroidal

FIG. 90.—Diphtheria.—*a*. Part of false membrane from a case of diphtheria, containing both streptococci and bacilli. *b*. Streptococci; *c*. Bacilli, viewed separately. × 950 diam.

masses, which may, if the preparation is defectively stained or insufficiently magnified, be readily mistaken for masses of micrococci (see fig. 90).

The diphtheria bacillus is minute, of very variable length, the rods not usually exceeding 6 to 8 μ in length, the individual elements 1·5 to 2·5 μ.[1] Both in the fresh condition and in sections it may be straight or slightly curved, often somewhat swollen, and showing either at the ends or centre of the rods more deeply stained portions, the relations of which to spores will be discussed later.

More important are the facts as to the cultivation and pathogenic reactions of the bacillus.

Cultivation.—Löffler first succeeded in obtaining pure cultures of the diphtheria bacillus on a mixture of serum and gelatinised meat-infusion. His medium is composed of three parts of calf or sheep blood-serum mixed with one part of neutral gelatinised veal-broth, to which have been added 1 per cent. of peptone, 1 per cent. of grape sugar, and ·5 per cent. NaCl. It can also be grown on blood-serum alone, on glycerine-agar, and in slightly alkaline meat-broth (veal-broth to be preferred).

Growth proceeds almost solely above a temperature of 20° C., and well at 37° C. (roughly speaking, 70° to 99° F.) A moist temperature of 60° C. kills diphtheria bacilli, whether in the cultivations or false membranes; but when dried they may resist a temperature of 98° C. for nearly an hour. When grown on Löffler's serum they form greyish-white colonies, which extend rapidly on the surface, and become visible to the naked eye in twenty-four to thirty-six hours. It is found that the growth of the first cultivation from false membrane is slower than that of the subsequent generations, probably owing to the more complete acclimatisation.

On agar the growth has a brownish colour, and the edges are more irregular. In broth the bacilli form small whitish clumps, which fall to the bottom or adhere to the sides of the vessel. They can also be readily grown in milk. Liquefaction of semi-solid media is never produced.

The diphtheria bacillus is one which grows best in the presence of oxygen, although in liquids it appears to be capable of some growth in the absence of free oxygen ('capably anaërobic').

The vitality of the bacilli appears to be very great. It has been already mentioned that in fluids they are readily killed by a temperature of 60° C. But at ordinary temperatures their duration of life is remarkable, and still more their power of resistance to drying, which is commonly soon fatal to spore-free bacilli.

[1] In this we have an illustration of the great variety of statements by different observers, due to modes of preparation and examination. Löffler said they were about the length of tubercle bacilli, but twice as thick. Others say: average 6 μ long, ·16 μ diameter; Zarniko, 1·5 to 2·5 μ long, ·3 μ broad. The latter is approximately correct for the fresh cultivated bacilli, but in hardened and mounted specimens the diameter appears much smaller.

Serum cultivations kept under ordinary conditions were found by Roux and Yersin to be living and active for five months (*Ann. de l'Instit. Past.* 1890), by Spronck (*Centr. f. allgem. Path.* April 1, 1890, p. 217) for three months. If air and light were excluded a similar result was observed after thirteen months (Roux and Yersin). Even in broth the vitality may be retained for three months (Spronck).

Still more remarkable is the result of *drying*. Thus, bacilli dried on threads have been recultivated after four months (Roux and Yersin), or even after six months by Spronck (*loc. cit.*), and showed no diminution in vitality or alteration in character. Portions of false membrane carefully dried and kept in the dark have been found to contain living and active bacilli after four months.

The bearing of these facts on the persistence of infection is of extreme importance. They have also great interest in relation to the question of the presence or absence of spores in diphtheria bacilli, and constitute a strong argument against the commonly accepted view that they are devoid of spores.

Modes of Staining.—The bacilli can be readily stained in the fresh condition either in the false membrane or in cultivations. Minute fragments or scrapings are squeezed between two cover-slips in the usual manner, and then dried. They may then be stained with alcoholic methylene-blue solution. They can also be stained with gentian violet, with or without Gram's method. Various other methods may also be employed, such as dahlia and methyl green in watery solutions.

When thus stained, these bacilli, like many others of analogous structure, show deeply coloured portions at the ends or centre of the rods, which are by many regarded as aggregations of protoplasm which take on a deeper stain, and as having no relation to spore-formation, especially as these so-called polar granules (*Polkörner*) do not stain with the special spore-staining methods. It would lead us too far to discuss this subject fully, but it appears to the writer that this conclusion is not warranted, for similar conditions are observed in many other bacilli in which these 'granules' almost undoubtedly have the relation of spores. The fact of possible variety in the character and formation of spores appears to have been lost sight of by many observers.

In addition to these granules, other granules, highly refracting and sometimes staining deeply, may be seen, especially in old cultivations, and the rods may show bulbous swelling of the ends or centre. These are doubtless degenerative changes or 'involution forms.'

In hardened and preserved sections the discovery of the bacilli is often a matter of far greater difficulty: they may sometimes be successfully stained with gentian or methyl violet, or with magenta. But, as with most preserved specimens, it is found that the number of bacilli is apparently far less than in freshly cut sections or scrapings.

Virulence and mode of action of diphtheria bacilli.—When cultivated under suitable conditions their virulence may be maintained through a long series of generations (150, Spronck). But the intensity of the virulence has been found by several careful observers to be subject to considerable modifications, and to vary much under conditions not yet explained. Some of these variations may be dependent on the different modes of cultivation; for example, when grown on glycerine-agar they appear to lose virulence sooner than on serum or on broth. Some definite observations indicate that this loss of virulence may depend on too long intervals between the generations, and on exposure to light and to excess of air. Indeed, Roux and Yersin state that if cultures made at 40° C. have a stream of air driven constantly through them for several days, the virulence may be almost entirely abolished.

On the other hand, it is found that old cultivations are highly toxic—*i.e.* when minute doses are injected they may produce the serious or fatal results of diphtheria, namely, general blood-poisoning, paralyses, or albuminuria, without the production of local lesions.

These facts are explained by a remarkable series of researches, especially those of Roux and Yersin, confirmed by others, which show that a poison is generated by the growth of the bacilli, which can be isolated, and to which the general symptoms of diphtheria are due. These researches are not only of great importance in relation to diphtheria itself, but throw a most valuable light on the general history of contagious diseases. They may, therefore, be selected as an illustration of the mode of investigation, and of the kind of evidence we have upon this important subject.

If a cultivation made in weakly alkaline broth is kept at a regular temperature, it is found after a time to become acid, and later again alkaline to a greater degree than before. At this period it becomes more highly toxic—that is, smaller quantities injected into the blood cause paralysis or death. If such a cultivation is filtered by a Chamberland filter, the resulting fluid which has thus been freed from the bacilli is found to retain its toxic properties. The filtrate contains at least two separable proteid substances, one of which has the special toxic properties, and is soluble in water but insoluble in alcohol. On concentrating the filtrate to one-third of its bulk by evaporation *in vacuo* at 40° C. and pouring it into absolute alcohol, to which a small quantity of acetic acid has been added, a greyish-white flaky precipitate occurs, which gradually sinks to the bottom.

By redissolving in water, and repeated precipitation in alcohol, with subsequent filtration and dialysis, this substance may be obtained in an almost pure condition, and may be dried *in vacuo* at a temperature of 30° C.

The material thus separated is a whitish amorphous powder, readily soluble in water, and easily decomposed by a temperature over 55° C. From its characters it appears to belong to the group of organic substances allied to ferments, which have been called enzymes. In solution it dialyses with some difficulty through animal membranes, a fact which may explain its slow absorption in some cases. It can be kept unaltered for five months in vessels from which light and air are excluded, but deteriorates if air has free access to it.

The animals which have been found to be especially susceptible, both to inoculated diphtheria bacilli and to the action of the separated poison, are rabbits, guinea-pigs, and pigeons; but even dogs can be affected by the poison. Mice and rats appear to be insusceptible.

When the poison or its solution is injected subcutaneously, or into the veins, it causes, if in sufficient dose, rapid prostration and death. If, however, the animal survives long enough, *paralytic phenomena* are observed, the parts usually first affected being the hind limbs, followed later by an irregularly distributed general paralysis, from which recovery sometimes, but rarely, occurs. *Albuminuria* also frequently occurs; this usually in the case of rabbits begins about the third to the fifth day (Spronck).

Anatomically there are found hæmorrhagic exudations in the peritoneum; scattered minute hæmorrhages, acute nephritis or extensive degeneration of the renal epithelium; and fatty degeneration of the liver. But no false membrane is observed, either at the point of inoculation or on the mucous membranes.

Similar results may be produced by injections of the culture-fluid itself, but the special reactions of the bacilli may then also occur.

Amongst the more striking facts known about the diphtheria poison is the neutralising effect of acids upon it. If a highly toxic alkaline culture is strongly acidulated even with lactic or acetic acid, the toxic property disappears, but on neutralising the fluid it reappears. Other vegetable acids also appear to hinder the growth of the bacillus, salicylic acid 1 in 2,000, or citric acid 5 per cent., having this property (d'Espine and de Marignac).

From these and other observations, the important conclusion appears warranted that the toxic effects of the diphtheritic virus are due to a poison which is generated by the growth of the bacillus; that it is formed locally in, and in the vicinity of, the false membrane, and is absorbed thence into the general system. The absence of the bacillus in the internal organs, a fact confirmed by all observers, is thus of no importance as an argument against its causal relation.

Brieger and Fraenkel have confirmed the results of Roux and Yersin in great part, but believe the poison of diphtheria not to be an enzyme, but a substance closely allied to serum-albumen, and which they call a tox-albumen.

Very important work on this subject has recently been done by Sidney Martin (*Goulstonian Lectures*, 1892)—important not only on account of the results already obtained by him, but also on account of the extensive field of inquiry thereby opened up. He has separated from the tissues of patients who have died of diphtheria two kinds of chemical substances, namely, albumoses (proto- and deutero-), and an organic acid, both of which have poisonous properties of the same nature, but those of the former are much more powerful. When injected into rabbits in certain doses certain symptoms follow—fever, diarrhœa, paresis, and loss of weight. The paresis generally begins in the posterior limbs, but the rest of the body becomes involved, the heart and the respiratory muscles also becoming affected. He finds that the paralysis is due to certain well-marked changes in the nerves, affecting first the myelin sheath, which breaks up into fragments and disintegrates; the axis-cylinder becomes thin, and may ultimately break across, so that in a motor nerve a degeneration spreads along the part beyond. These changes occur regularly in patches, and affect sensory as well as motor nerves, whilst the central nervous system is unaffected. Fatty changes are found in the associated muscle-fibres, and the heart also shows signs of fatty degeneration. The extract of the proteids of the diphtheritic membrane, prepared in the same way, has the same action, but is much more powerful; and he considers this to be due to the presence of a ferment (enzyme) in the membrane, which when introduced into the body is capable of producing more albumoses with the same properties. The chain of events is thus the following: The bacillus by its growth in the membrane produces a ferment, which by its local action produces albumoses in the membrane, and is also absorbed into the circulation, forming from the proteids of the blood, especially in the spleen, similar albumoses, which have certain definite poisonous actions, the most important being on the nervous system. He finds that these products are similar, both chemically and in their physiological action, to the substances produced by the organism when grown in meat-broth with alkali-albumen added.

As a general result of the experiments of several observers, it has been found that when

the diphtheria bacillus is introduced into the fauces or trachea of an animal, it has no effect unless the mucous membrane has been abraded, but if previously abraded it causes local spreading inflammation with the formation of false membrane. The false membrane is soft and pultaceous in many cases, and spreads rapidly. It contains the bacillus in great quantity, and otherwise corresponds generally with the human disease. In some cases, if injected into the trachea by puncture, the diphtheritic process may start in the small wound made. Subcutaneous or intravenous injections are without effect, unless the quantity of the poison present is sufficient to be harmful, or unless some local reaction occurs superficially at the site of puncture, as the bacillus cannot grow in the blood or viscera.

Although there are undoubted gaps in our knowledge, the conclusion from the facts here briefly summarised seems almost inevitable that the virus of diphtheria is the Klebs-Löffler bacillus. One or two objections may be briefly mentioned. It is alleged that a bacillus, indistinguishable from the diphtheria bacillus, is present commonly in the secretions of the mouth of healthy children; and in a few cases of sore-throat of doubtful nature this 'pseudo-diphtheritic bacillus' has also been found. Attempts have been made to establish precise morphological distinctions between the 'pseudo-diphtheritic' and the true diphtheria bacillus, but these distinctions of form and mode of growth are not highly characteristic.

Roux and Yersin, who carefully examined the secretions of the mouth of fifty-nine healthy children in a district remote from diphtheria, found these pseudo-diphtheritic bacilli in twenty-six cases; and they further state that cultivations of these differed hardly perceptibly from those of the true diphtheria bacilli, which had been partially rendered innocuous by the air-stream method above described.

But they found that the virulence of the diphtheria bacilli could be restored if they were inoculated, together with Fehleisen's erysipelas micrococcus, into guinea-pigs, regaining entirely their original vigour after a few transmissions from animal to animal. No such result has been attained with the pseudo-diphtheritic bacillus.

In reality there is very little ground in the objection that, because a bacillus closely resembling the diphtheria bacillus is innocuous, the latter is only a common innocuous bacillus, which has acquired accidental toxic properties. Our means of distinguishing the different species are as yot very imperfect, and the pseudo-diphtheritic bacillus may be as injurious to some animals as the diphtheritic to others, the latter itself being innocuous to mice. The essential specific distinction is the poison it generates, and the peculiar effects which it produces. Many of its other characters are common to bacteria which are widely distributed in nature.

It may be asked what part is played by the micrococci which are so frequently present, in the false membrane, in the tissues of the throat, and in the swollen glands, and with less constancy in the other organs. It is highly probable that they aid in exciting inflammation and subsequent suppuration. The experiments of Roux and Yersin already referred to will, if confirmed, tend to support the suggestion that they may aid in the preparation of a suitable nidus for the otherwise insufficiently active diphtheritic virus.

From the facts thus related some practical inferences may be drawn. The diphtheritic virus has a high degree of tenacity of life, and can remain long dormant when dry. Hence the great importance of very thorough disinfection of all infected rooms, houses, fomites, &c., and especially those which may have been in contact with the secretions of the mouth or throat. The recurrence of diphtheria in dwellings is readily explained by the known bacteriological facts.

The diphtheria bacilli are found to remain in the oral secretions of patients for some days after apparent convalescence. Hence all cases should be kept isolated, and the mouth disinfected, for at least a week or two after apparent cure.

The fact that the poison is secreted in and around the false membranes suggests their removal where possible, or constant disinfection, and points to the probable value of lactic or acetic acid as local agents for neutralising the poison; though it must be remembered that this action is only temporary. Early local disinfectant treatment should be adopted in all suspicious cases, especially during epidemics, as the bacillus multiplies with great rapidity in the mouth and fauces.

Prophylactic inoculation has not been found possible. Clinical experience shows that diphtheria is not one of the diseases which affords protection against a second attack. Very recently it has been alleged that one of the proteid substances obtained from cultivations of the bacillus renders animals insusceptible after the lapse of a certain time; but further confirmatory evidence as to this statement is required.

19. Typhoid Fever.—Enteric or typhoid fever is one of the diseases in which the apparently constant presence of a bacterium possessing peculiar characters in the parts especially affected by the disease, has led to the belief in its pathogenic nature. The organism is now generally known as the *typhoid bacillus*. As yet we lack complete experimental evidence of its causal connexion with the disease. But its peculiar characters, and its definite association with the special lesions in the intestines, mesenteric glands, and spleen, particularly in the earlier

stages of the disease, render its provisional inclusion amongst pathogenic bacteria justifiable. It is true that the entrance of bacteria into diseased parts of the intestine is easy, and that the characters which this bacillus presents may be proved later to be not distinctive; but the early and special association with the diseased parts, and the absence of other common bacteria at the same period, add weight to its claims.

The first definite discovery was announced by Eberth in 1880 (Virchow's *Arch.* 83, p. 486); and the more accurate study and cultivation of it by Gaffky (*Mitth. a. d. K. Gesundheitsamte*, ii.) in 1884. Their work has to a large extent been subsequently confirmed by numerous observers.

Site.—The typhoid bacillus is found in the swollen Peyer's patches and solitary glands during the early stages of the fever, and also in the mesenteric glands, spleen, and liver. It is usually in colonies or clusters, formed of bacilli closely massed together (but the colonies widely scattered), and around them there is active proliferation and degeneration of the tissue-elements. The bacilli are usually short, somewhat thick, with slightly rounded ends, measuring about ·4 to ·6 μ in diameter, and 2 to 6 μ in length. In some situations their length may be greater. They frequently show spore-like bodies at the ends and centre, whose relations have been discussed above (*see* Diphtheria). They may be brought into view by various aniline dyes, especially by methylene blue, but often require special methods and careful search. They are usually decolorised by Gram's

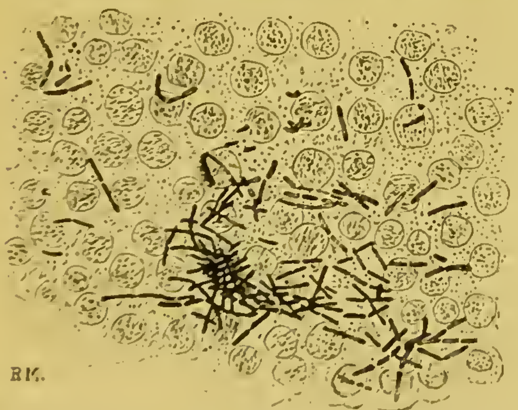

FIG. 91.—Typhoid Bacilli in section of a swollen Peyer's patch. Showing the usual appearance in stained sections. × 950.

method, unless the sections have been previously treated with corrosive-sublimate solution: even then they may be difficult to stain. As the disease advances, they appear to diminish in number, or are much more difficult to detect. Their presence has also been demonstrated in the dejecta of typhoid patients (Pfeiffer).

Gaffky succeeded in cultivating typhoid bacilli on nutrient jelly. They appear as somewhat rounded colonies on the surface of the jelly, which coalesce and spread upon the surface, forming a thin layer which acquires a slightly brownish tinge. They do not liquefy the jelly. In puncture-cultivations growth appears as a whitish line along the needle-track, but spreads specially on the surface as a flat whitish layer with a shining appearance, which may reach the wall of the test-tube. From the mode of growth they are evidently highly aërobic, but are said also to be capably

FIG. 92.—Typhoid Bacilli.—Stained to show cilia. × 2,000 diam. From a specimen prepared in the Berlin Health Laboratory.

anaërobic. In fluids they grow freely, as in broth or milk, causing but little change in the latter. Some growth occurs even in water. They are found to be motile when examined in fluids, and show a peculiar wavy or serpent-like motion, which is seen best in the longer threads. When grown upon potatoes they produce a delicate transparent layer, which is almost invisible if the potatoes have an acid reaction, slightly yellowish or grey if alkaline. The surface becomes covered in about two days at a warm temperature (38° C.), in three to four days at ordinary temperature. Longer filaments are formed in cultures than in the tissues.

A recent discovery of considerable importance is that of the peculiar characters of the cilia of typhoid bacilli, seen, by means of Löffler's method, best in young cultivations (six to eight hours) on serum. Each bacillus appears to be surrounded by a hyaline sheath, from which a large number of irregularly arranged cilia run outwards in all directions, most being lateral. Their appearance is well seen in fig. 92. This character was at first believed to be unique, but some other bacilli have since been found to possess cilia arranged in the same way. Besides, we cannot with our present means determine the constant presence of these cilia under all conditions in fluids or in sections, and their value as a diagnostic aid would be limited by this fact, even if they were peculiar to this bacillus. Nor are any of the other

complex and delicate methods which have been proposed of distinguishing by cultivating under different conditions, &c., sufficiently certain to afford a foundation for absolute diagnosis.

It has also been alleged that the typhoid bacilli possess a greater power of resistance to heat than some others which are closely allied to them, and that they can develop in the presence of carbolic acid in the proportion of 2 to 1,000. This fact, first stated by Chantemesse and Widal to be characteristic, has proved to be common to them with some other bacilli. Moreover, some observers have failed to cultivate in this way some bacilli which had all the other common characters of typhoid bacilli (Martinotti and Barbacci).

Very numerous experiments have been made by inoculations of cultivations of the typhoid bacillus in animals. Injections have been made subcutaneously, into the blood, into the peritoneum, directly into the duodenum, &c., but in no case with results which are at all conclusive. Many animals die in a day or two with symptoms of septicæmia, sometimes with emaciation and diarrhœa, whilst swelling of the spleen and of the lymphoid patches in the intestine has been found in certain cases; but similar conditions have been produced by sterilised cultures, and the results appear to be of the nature of an 'intoxication' rather than a disease with specific localised lesions. Moreover, similar results have been produced by the injection of the products of other organisms, and therefore they are not characteristic of the typhoid bacillus. A disease essentially similar in its characters and lesions to typhoid has not been, and possibly cannot be, produced in the lower animals.

In the absence, therefore, of direct experimental proof, our knowledge must be chiefly guided by the presence of the organism in cases of typhoid, its relations to the spread of the disease, &c. Here, however, there arises the difficulty of definitely distinguishing this bacillus from others which have been found to resemble it closely. For example, Cassedebat found in Marseilles water 'three pseudo-typhoid' bacilli, which resembled the typhoid bacillus in all the chief particulars, and could only be separated from it by the change produced by their growth in gelatine coloured with aniline dyes, by the degree of turbidity produced in broth, and by some minor differences observed when they were grown side by side. Accordingly, various peculiarities of the typhoid bacillus have been described as an aid in diagnosis, such as the growth in media containing a small quantity of carbolic acid (Chantemesse and Widal), the negative indol reaction (Kitasato), the growth in acid peptone gelatine coloured with gentian violet (Uffelmann). The method of growing it in the presence of carbolic acid, introduced by the writers mentioned, and since modified in various ways, though not sufficient to distinguish the typhoid bacillus from all other bacteria, has been found in the hands of many to aid in its separation when many putrefactive organisms are present. Vincent, for example, found that, by adding ·7 per cent. of carbolic acid to the medium and incubating at 42° C., most organisms are killed; and by this method, followed by plate-cultivations, he succeeded in cultivating the typhoid bacillus from the Seine water in Paris. Thoinot, Loir, and others also cultivated it from the same source. None of the methods mentioned have yet been accepted as giving results which are quite characteristic of this organism, though by taking all the characters together it may be found possible to separate it from all other organisms.

Statements regarding the discovery of the bacillus in earth, water, &c., must therefore be received with a certain degree of caution, though the results in some cases, ascertained with great care, may be perfectly reliable. The bacilli have been found to remain alive in water for a considerable length of time, and cultivations have been made from fæces which had been kept in a sterilised tube for fifteen days. The facts known therefore with regard to their conditions of growth, &c., make it probable that in sewage-water they can live for a considerable length of time, and even multiply to some extent. Gaffky found that at a suitable temperature typhoid bacilli formed terminal spores, and that the spore-bearing bacilli could withstand drying for three months at least. The conditions of life and of growth of the typhoid bacillus are such as to make a saprophytic existence outside the body very probable.

The large number of cases of typhoid in which the bacillus has been found, the definite relations to the lesions, and its vital properties, make it very probable that it is causally related to the disease, but complete proof is still wanting. Moreover, much work still remains to be done in the direction of separating and distinguishing the members of what appears to be a group of bacilli, closely allied to the typhoid bacillus. According to Babes (and apparently Klebs holds a like opinion), considerable varieties also exist in the precise characters of the bacilli cultivated from different forms of typhoid.

It does not appear to the writer that there are as yet sufficient means of distinction of typhoid from other bacilli by form of growth or modes of cultivation. A study of specimens of cultures from various laboratories has shown them that the organisms which are being studied in different places as 'typhoid bacilli,' whilst closely similar in appearance and mode of growth, do not present the same kind of ciliation when studied by Löffler's method. A revision of the entire subject appears to be necessary, before we

can arrive at definite conclusions as to the relations of the bacillus to the disease.

20. **Influenza.**—During the recent epidemics of this disease a vast amount of bacteriological work has been done with a view to discovering the specific virus, and a great many micro-organisms have been isolated from the bronchial secretion, blood, &c. Of these the most commonly mentioned are diplococci, very similar to the 'diplococcus lanceolatus' of pneumonia, as described by Babes, Kirchner, Weichselbaum, and others. Recent observations have, however, shown that these are probably not peculiar to the disease, and that the influenza microbe is an exceedingly minute bacillus with definite character. An account of this organism was published simultaneously in January 1892 by Pfeiffer, Kitasato, and Canon (*Deutsch. med. Woch.*), though the bacillus may be one of the many organisms previously observed by others. The two first-mentioned observers found it in the bronchial secretion, and succeeded in obtaining pure cultivations. Canon observed the same bacillus in the blood of influenza patients, especially during the fever, and later succeeded in cultivating it from the blood. The bacilli are exceedingly thin and relatively short, and are found in the sputum in enormous numbers, occurring singly, in pairs, or in short rows. In the blood they are generally very few in number. (One of the writers observed similar bacilli in the blood during the high fever in influenza in February 1891.) They are stained with some difficulty, a dilute Ziehl's carbol-fuchsin solution or warm methyl-blue solution (Löffler's) being very suitable. On glycerine-agar, growth appears as minute colourless drops, for some time almost invisible to the naked eye, which generally remain separate, having little tendency to run together. Kitasato examined the sputum in a large number of other diseases, and never found this organism. Pfuhl (*Centralb. f. Bakter.* 1892, i. p. 397) has found the same organism in the sputum in influenza, and obtained pure cultivations from nine cases, but has found it only exceptionally in the blood. It is the opinion of some that the common site of the organism is the mucous membrane of the respiratory passages, and that it enters the blood only at certain stages.

Much more extensive observations are necessary, and a full account of the action of the bacillus on animals is still wanting. It is, however, evident from what we now know of this affection, that if a bacillus with peculiar characters can be cultivated both from the bronchial secretion and from the blood in influenza, there is a very strong probability that it is causally related to the disease.

Group VI.—*Other Diseases in which a Bacterial Virus has been assumed or alleged, but is at present doubtful.*

21. **Other Diseases.**—In addition to the above diseases, whose relation to micro-organisms has been more or less satisfactorily established, there are a number of others which, from their analogous characters, we should expect to be due to a somewhat similar cause. Such are, for example, scarlet fever, measles, yellow fever, &c. From time to time discoveries have been announced of bacteria as the specific agents, but as yet it cannot be said that any sufficient proof has been given of their causal relation. With regard to yellow fever, specific micro-organisms are asserted to have been found by various observers, and even a method of preventive inoculation has been announced; but since the work has not yet been accepted as possessing scientific accuracy, it appears unnecessary to give details. In dysentery, also, various organisms have been discovered, and some observers are in favour of the view that dysentery is not due to a bacterium but to the amœba coli, which has been found in the intestine, and also in the secondary abscesses in the liver in this disease. But whether its presence is only accidental, or has any causal relation, is yet uncertain.

Malarial Fever.—An article of this kind would be incomplete if no reference were made to the discoveries of organisms in the blood in malarial fevers, which are now accepted by nearly all competent authorities as causally related to the disease.

The early observations of Tommasi-Crudeli and Klebs, on the presence of a characteristic bacillus in malaria, have not been confirmed, and there is now a general consensus of opinion that the specific organisms present are not bacteria, but belong to the group of protozoa. These organisms were discovered by Laveran in Algeria, and described in November 1880, and his observations have been substantially confirmed by numerous observers in various parts of the world—by Marchiafava, Celli, and Golgi in Italy; by Osler, Councilman, and James in America; by Vandyke Carter in India; and by many others. Some of these, notably Marchiafava and Celli, made the discovery independently, although at a later date than Laveran.

The organisms occur in several forms, in the numerous descriptions of which there is considerable uniformity, though the appearances have been variously interpreted. Laveran arranges them into four classes, as follows:—

(1) *Spherical bodies*, which measure from 1 to 9 μ in diameter, and occur within the red corpuscles, and also free in the serum. They are small masses of hyaline protoplasm, and possess active amœboid movements,

which can be studied by means of a warm stage. With the exception of the smallest, they contain dark pigment-granules, which are evidently formed from the hæmoglobin, which is destroyed as they grow within the red corpuscles, the largest of the bodies, as a rule, containing most pigment. As many as four may be found within a red corpuscle, though they generally occur singly. The spherical bodies are those most commonly seen.

(2) *Flagella and flagellated organisms.*—The flagella appear to form by an outgrowth from certain of the larger spherical bodies, which have become free, and there may be one to four flagella attached to one organism. They have a very rapid lashing movement, which is best seen when becoming slow owing to cold or coagulation. The length of the flagella measures three to four times the diameter of a red corpuscle, and they are of extreme tenuity. They may become detached, and then possess an independent movement of their own in the serum. The flagellated organisms are frequently observed, but less often than the spherical bodies.

(3) *Crescentic bodies.*—These are found free in the serum, are non-amœboid, and measure 8–9 μ in length. They are generally crescentic in shape, sometimes sausage-shaped, and a fine curved line is occasionally seen joining the extremities, which has been regarded by some as indicating the remains of a red corpuscle, whose hæmoglobin has been absorbed by the parasite. They are colourless and transparent, and generally show a small collection of dark pigment about their middle. Some of them afterwards become round or oval. They are most commonly found in malarial cachexia (Laveran), or in the irregular types of fever (Golgi and others).

(4) *Rosette-shaped or segmented bodies.*—These are somewhat spherical bodies, generally a little larger than a red corpuscle, presenting a central mass of pigment-granules, sometimes surrounded by a hyaline envelope. From the centre radiating lines pass to the periphery, indicating a regular segmentation of the protoplasm, and they appear to split into smaller ovoid or elongated bodies. This form is rarer than the others, and is seen especially in the quartan type. They are generally regarded as formed by a segmentation of the intra-cellular spherical bodies.

Methods of examination. — All these varieties are best studied in the fresh blood on a warm stage. Dried films of the blood, after being fixed by heating, may be stained for thirty seconds in a saturated watery solution of methyl blue, and then washed in water. They may be mounted dry, or in Canada balsam. These preparations show all the forms except the flagella.

Regarding the relations of these different forms to one another, there has been, and still is, much dispute. That the spherical bodies gradually enlarge within the red corpuscles, destroying the hæmoglobin, and may afterwards undergo segmentation, producing in some cases the rosette-shaped bodies, all observers are practically agreed. According to Golgi, Celli, and other Italian observers, the crescents and flagellated organisms represent sterile vegetation forms, which have become free before segmentation has occurred, and are incapable of further development; whereas Laveran considers the flagellated body, at least, to represent the stage of full development, which is extra-cellular. Laveran also considers that all the different forms are merely stages of the same organism, and that, although some of these are more commonly present in certain varieties of fever, yet they are not strictly related to the clinical types, *e.g.* though the rosettes are most commonly found in the quartan type, they are not peculiar to it. Most of the Italian observers, on the other hand, hold that there are distinct kinds of parasite, corresponding to the types of malarial fever, some considering that there are three varieties of parasite, others that there are only two. They consider that the different varieties of parasite have different periods, during which they pass through the whole cycle of their development, and that these periods determine the type of the fever. This view of distinct varieties of parasites, however, as Laveran points out, is not fully supported by the appearances found in the blood, and is difficult to harmonise with clinical facts.

The evidence that these organisms are causally related to the disease may be briefly summed up thus. Their presence in the blood in malarial fever has been observed in widely distant parts of the world, and practically all are agreed regarding the microscopic appearances; and they have been found in the human subject in no other conditions. They are present in the blood during the paroxysms of fever, and almost completely disappear when the fever subsides. They also disappear from the blood under the influence of quinine, an exception being formed by the crescents, which may persist for some time. They account for the destruction of red corpuscles with consequent anæmia, and also for the pigmentation consequent on what was formerly called melanæmia, the pigment-granules being taken up chiefly by leucocytes, and deposited in various parts of the body. And, lastly, although cultivations of the organisms outside the body have not been obtained, inoculation with blood containing them has reproduced the disease in man, with their multiplication in the blood (Celli and others), and it is also stated that a similar result has been obtained in apes. It is still quite unknown where and in what form they exist outside the human body, how

they gain entrance into the body, and by what means they produce the fever.

It is also interesting to note that a somewhat similar, though quite distinct, variety of organism has been found in the blood of birds, in which they cause a certain disease. Here, again, they are situated within the red corpuscles, the hæmoglobin of which they destroy. Papers on this subject have been published by Danilewsky and others, and the work which is being done is certain to throw light on many points which are yet obscure in connexion with malaria.

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MICROSCOPE in MEDICINE.—It must at the outset be recognised that the microscope is but an aid to one of our senses. It merely extends our means of observation, of seeing what is. The range of our vision being limited, this optical arrangement permits a wider field, a greater depth of perception. Of itself the microscope allows the hitherto hidden, only because too minute, to be seen, whilst it discloses nothing that does not already exist; it renders, in short, the eye for the time being and in one direction more perfect.

The formation of a diagnosis, which may be regarded as the first aim of practical medicine, is the result of a judgment founded upon observation of the case, guided by experience and with due regard to external circumstances. Any agent that extends the means of observation, or renders such more accurate, is obviously a great gain; and on this ground the microscope ranks with the stethoscope, the thermometer, the ophthalmoscope, and the probe, which permit a wider application of the senses of hearing, sight, and touch. But whilst perhaps it may be conceded that the microscope for daily practice is not of such necessity as either of those instruments, it has a further and greater claim on the consideration of the medical man, for what it has done and is doing in laying the foundation of the science on which his practice depends.

That which characterises the theories of pathology at the present day, and which markedly distinguishes them from any and all hitherto taught, is the recognition of the association and dependence of function upon structure, with the subsequent corollary that disease is but altered function due to altered structure. Whilst the knowledge of the structure of the body—anatomy—was, previous to the present century, of the coarsest character, the theories of disease were limited only by fancy and empiricism. But as the great truth which established the connexion of physiology, and hence of pathology, with anatomy came more and more to be recognised, the principles of morbid action, the explanation of symptoms, and the suggestion of rational treatment followed on truly scientific grounds. It was in establishing, and is now in maintaining and following this truth, that the microscope ranks highest among our instruments of research.

The Instrument.—In face of the many and excellent instruments that are offered, it would be invidious to recommend any particular one; but the following remarks are intended to be a guide as to the kind of microscope that is sufficient for the ordinary requirements of the practitioner, it being assumed that the optical principles of a compound microscope are understood, and that its various parts are known by name, and that the workmanship of the instrument shall be of the best. The ordinary work of a microscope may be said to consist of examining various secretions, histological specimens, &c., for which powers not greater than one-quarter to one-sixth inch are required. But for certain kinds of work (as the examination of micro-organisms) much higher powers are necessary, and the employment of these demands corresponding changes in the stand and its accessories.

Of a microscope-stand, one of its principal merits should be steadiness, a quality derived from its shape and not from factitious weighting. The tube should be movable quickly up and down by a 'coarse' adjustment and slowly by a 'fine' adjustment. The importance of the latter can hardly be overrated, for in one sense a microscope-stand may be expressed as a fine adjustment. The tube should be capable of being inclined and of remaining steady in any position between the perpendicular and horizontal, the latter position being required for drawing with the camera lucida and for photographic purposes. The tube should be fitted with a nose-piece, an apparatus for carrying two to four objectives which are made to focus at the same level by means of 'adapters.'

Every microscope should possess a 'substage condensor,' fitted so that it may be focussed by a rackwork and accurately centred. The best form is the 'Abbe' achromatic condensor, and the amount of light may be conveniently regulated by an 'iris' diaphragm; but this may also be effected by means of a 'turnout' arm, in which are placed 'stops' of various size and shape. The 'mirror' for reflecting the light is flat on one side and concave on the other. The 'plane' surface should be used in conjunction with the condensor.

The most important part of a microscope is the optical, viz. the objectives and the eyepieces. These are constructed of different kinds of glass. Ordinary lenses made by combinations of crown and flint glass are known as 'achromatic' lenses from their quality of rendering the 'dispersion' comparatively inappreciable. There always remains, however, more or less of this dispersiveness, a

condition known as the 'secondary spectrum.' Comparatively recently a new vitreous compound has been devised, and from this are made 'apochromatic' lenses by which, in combination with specially constructed eye-pieces, the secondary spectrum is quite abolished and the image is, when properly focussed and illuminated, really achromatic. These objectives are specially valuable for photomicrography and for the examination of micro-organisms.

The lens is also 'dry' or 'immersion' according as the preparation is viewed through air or some liquid medium—water or oil—placed between the cover-glass and the face of the objective, the main object of the immersion being to increase the amount of light; for as the power of the lens increases so does its face decrease in size, and consequently the amount of light admitted becomes necessarily limited. Passing through air, light is more scattered or deflected than through liquid, hence the loss is naturally lessened by the immersion lens. Cedar oil is generally used, having, when inspissated, a refractive index of 1·51. But the latest development has been to make the immersion system 'homogeneous;' in other words, to have all the media between the objective and the preparation of similar refractive and dispersive power. High-power lenses are, or should be, provided with a screw collar, in order to correct for different thicknesses of cover-glass.

The remainder of the necessary optical apparatus consists of eye-pieces or oculars. These are 'positive' or 'negative' according as they focus within or without the ocular when used as a simple microscope. They are made of various strength, and this is inversely as their length—*i.e.* the longer they are the weaker they are. The weaker eye-pieces have less magnifying power; but much more light and better definition are obtained with them than with the short oculars with their greater magnification. For apochromatics the eye-pieces are of special construction, and in order to 'compensate' for the lens they are 'over corrected.' They are of two classes, the 'working' eye-piece and the 'projection' eye-piece, the latter being chiefly employed for photographic purposes.

For artificial illumination—which is often preferable to daylight—a common mineral oil lamp, with a flat half-inch wick, is all that is necessary even for the best work; but a lamp which is provided with a black metal chimney, can be placed in any position, and can be fed without being moved, is of great advantage to the worker. The edge of the flame gives better illumination than the side when the light passes through a condenser.

We have now touched upon the microscope and its indispensable accessories as it affects the requirements of the medical student and practitioner in prosecuting ordinary histological work, the examination of urine, of various secretions, &c., for which purposes an inch and one-sixth inch are the only objectives absolutely necessary. But now, from the almost hourly need of examining tissues and secretions for micro-organisms, it is obvious that the instrument must be more expensive, because additional apparatus is required, which in turn necessitates greater costliness in the stand and its accessories. Ten years ago ten pounds was enough to spend on a microscope, which fulfilled all professional needs. To-day twice that sum is barely sufficient.

In selecting an instrument suitable for working purposes, we should advise a medium-sized stand, having a roomy stage, fitted with double or triple nose-piece, an Abbe condenser, an iris diaphragm, three objectives—viz. 1-inch, $\frac{1}{6}$, and $\frac{1}{12}$ oil-immersion, and two oculars.

With regard to the apochromatics, it may be admitted that their price renders them microscopical luxuries; and yet the dry $\frac{1}{6}$ apochromatic, having a magnification equal to that of an ordinary $\frac{1}{12}$ oil-immersion, possesses inestimable advantages for the examination of fresh fluids, and especially for observations on the blood.

On the border-line between indispensable and dispensable comes the 'mechanical stage,' an arrangement whereby the preparation can be moved up and down and to and fro by rackwork. But a small amount of practice with the fingers, and the fixation of the slide with a couple of spring clips, will enable most persons to move a slide about with equal smoothness and precision to the mechanical stage. Indeed, the presence of the milled heads, which project to one side of the stage, are to be regarded as an encumbrance. But the advantages of both conditions may be combined by having a 'movable stage.'

Another accessory is the 'finder,' of which there are several varieties, the most convenient being that where the vertical and horizontal stage-plates are graduated. By noting the numbers on the scales, the situation of any given spot on a preparation can be recorded, and the slide can thus be placed in the same position at any future time.

Measuring.—This is effected by either the stage or eye-piece micrometer. The former is merely a slide on which are a series of parallel lines ruled according to the English or to the decimal scale; say that the lines are $\frac{1}{100}$ or $\frac{1}{1000}$ of an inch apart.

One form of eye-piece micrometer is a simple and inexpensive apparatus, in which case it consists of a glass plate to be slipped into the eye-piece, and on it are marked a series of parallel lines. Now since the value of the marks in the stage micrometer are fixed and known quantities, it follows that for any

given tube-length the value of the distance between the marks in the ocular micrometer is obtained. Except for low and medium powers this is not a very accurate method, and for minute objects the 'screw micrometer eye-piece' is required.

Drawing.—It is frequently necessary that an accurate drawing should be made of the object seen; and this may be done by means of the camera lucida, an apparatus which is fitted on to the eye-piece. According to its construction, the camera is used with the microscope in the horizontal and in the vertical position, and also at an angle of 45°. The simplest and cheapest is the neutral-tint reflector. In using this it is necessary to keep the paper and instrument in exactly the same position, and to 'balance' the lights. This means that the light of the room and the illumination of the specimen must be so arranged or balanced that both the outline of the image and the pencil-point are well seen. The distance between the slide and the eye-piece and that between the eye-piece and the paper (the microscope being horizontal) must be the same, for if the latter be greater than the former then the paper-image will be greater than the object-image, and *vice versa.*

It is an easy inference from the use of the stage micrometer and of the camera that a combination of the two may be used for ascertaining the magnifying power of a lens; thus, if the lines on the stage micrometer $\frac{1}{100}$ inch apart are, when thrown on the paper, measured to be equal to 1 inch, then its power is represented as '× 100,' and so on.

Apparatus and Reagents.—Bearing in mind that it is for the clinical use of the instrument, rather than as a means of histological research, that the microscope is here considered, the actual reagents and apparatus required are very few. The following are requisites: A pair of small curved scissors, a pair of fine pointed forceps, a pair of 'cover-glass' forceps, for which epilation forceps are admirably adapted, a few sharp needles, mounted in handles, those with cutting edge being preferable, slides and cover-glasses, which latter cannot be too thin, several camel's hair brushes, one or two glass rods, lifter, bibulous paper, and pipettes. The slides and cover-glasses, used as well as new, are best cleaned by immersing them for several hours in strong nitric or sulphuric acid, and then washing them in running water to completely remove the acid. They should be kept in covered jars containing strong methylated spirit.

Except for the examination of tumours and new-growths, which may require hardening and staining, the medical man chiefly wants a microscope to ascertain the nature of various secretions and discharges, which are mostly of a fluid nature, and do not require the addition of any medium; but should any such be needed, it is desirable that it should be inert, and as nearly as possible of the density of the blood-serum with which the tissues are normally moistened. For this purpose a $\frac{3}{4}$ per cent. solution of chloride of sodium, or a 3 per cent. solution of glycerine in distilled water, to which a few crystals of carbolic acid have been added to prevent the growth of fungi, is most convenient.

For fixing and hardening portions of tissue the safest method is to immerse pieces in Müller's fluid (bichromate of potassium $2\frac{1}{2}$, sulphate of sodium 1, water 100) or in 2 per cent. bichromate of ammonium solution. The fluid must be constantly changed until it remains clear. According to the size of the pieces, the preparation will be sufficiently fixed in a few days to a few weeks. When required for examination the pieces should be further hardened by immersing them for one to several days in strong methylated spirit. The spirit is then extracted in water and the pieces soaked in mucilage of acacia (B.P.) for twenty-four hours, after which they are sectioned by means of an ether freezing microtome, the best form of which is the 'Williams.' In using this instrument it is only necessary to be careful that the knife-edge is perfectly parallel to the plate. The gum having been dissolved out in lukewarm and afterwards distilled water, the sections are stained. This is best done with one of the numerous logwood solutions, and afterwards with some red or red and yellow dye such as picrocarmine or acid-rubin, or the latter in combination with acid-orange. The sections are then mounted either in an aqueous or a resinous medium. If the former, then after having been 'cleared up' in $\frac{1}{2}$–$\frac{1}{3}$ glycerine solution, they are best permanently preserved in Farrant's medium. If the latter, then, after having been dehydrated in alcohol, they are cleared up in oil of cloves and mounted in balsam or dammar dissolved in xylol, benzol, turpentine, &c.

The foregoing is a very brief sketch of a practicable procedure, attainable by any one in a comparatively short time and at a very moderate cost.

Space does not permit more than merely to mention the more elaborate processes of the paraffin and celloidin methods. These not only require more time, but are more costly than the method just outlined. Nor can we allude to the numberless methods of staining requisite for demonstrating particular elements, but we append a few formulæ which are in general use for staining sections and cover-glass preparations.

1. Ehrlich hæmatoxylin solution.—Dissolve hæmatoxylin crystals 1·5–2 grammes in 100 c.c. absolute alcohol; add distilled water and glycerine āā 100 c.c., glacial acetic 5 c.c., and as much potash alum as the mixture will take up. Do not filter and expose to the light until the solution is of a port-wine hue. When

'ripe,' add a few drops of this solution to a watchglassful of distilled water. The sections stained red are transferred to tap water, wherein they become a beautiful blue.

2. Picrocarmine, to be used as a contrast stain, is better purchased than made; one of the most efficient formulæ is that invented by Ranvier.

3. Acid rubin.—The solid pigment is dissolved in distilled water. A few drops of the strong solution to a watchglassful of distilled water.

4. Alkaline methylene-blue solution.—Saturated alcoholic solution of methylene blue, 1 vol., KHO (1–10,000 H^2O) 3 vols.

5. Acid methylene-blue solution.—Saturated alcoholic solution of methylene blue, 1 vol., acetic acid (0·3 per cent.), 3 vols.

Both these methylene-blue solutions are very useful for micro-organisms, either in sections or in cover-glasses. If the alkaline be not successful, the acid often is.

6. Gram's method.—Saturated alcoholic solution of gentian violet, 10 c.c., anilin oil water, 100 c.c. After staining, the preparations are treated with the following until they turn black: Iodine 1, iodide of potassium 2, water 300; then with alcohol; the after-treatment being the same as for other section or cover-glass preparations.

7. Stain for tubercle bacillus and leprosy bacillus, &c:—

(*a*) Saturated alcoholic solution of fuchsin 10 c.c.; carbolic acid in 5 per cent. solution 100 c.c.

(*b*) Sulphuric acid 20 c.c.; alcohol 30 c.c.; water 100 c.c.; methylene blue to saturation; filter.

Cover-glass preparations are made by allowing a thin stratum of fluid to dry on a cover-glass, or if viscid—*e.g.* sputum—by squeezing a small quantity flat between two glasses, and by drawing, not pulling, them apart. The layer should be thin and even, a mere film. The 'cover' is next dried in air and 'fixed' by waving it two or three times through the flame of a spirit-lamp. The covers may then be stained by floating them on any appropriate solution, or by the method for staining tubercle bacilli as described below. *See* Section D, Sputum.

Clinical Uses.—The microscope may be applied to the investigation of the various discharges and secretions from the body, with the result of obtaining information, which, though often of but imperfect value, may on other occasions be of the most positive and precise character, determining a diagnosis which without it would be uncertain.

(A) **Urine.**—It may be taken as a fundamental principle that perfectly healthy, fresh urine should have no visible deposits. A small quantity of flocculent mucus, entangling a few epithelial cells, is, however, of such frequent occurrence and of such trifling importance as practically to come within the limits of health. More than that is abnormal, and demands investigation. It may be that they are only the result of changes in the urine after it is passed, or, on the contrary, they may have been voided as such. Occasionally absolutely clear-looking urine may contain tube-casts, which the microscope only can detect.

It is important, therefore, to know the age of any sample of urine that is examined, and, when possible, a portion of the whole twenty-four hours' quantity should be taken. Where this cannot be done, what is passed in the morning on rising should be chosen, since it is in such a specimen that certain objects are most likely to be present. Frequently an examination for several successive days may be necessary, for there are some conditions of kidney-disease in which but very few casts are passed, and would most probably escape one examination of a haphazard specimen. The urine should be collected in conical glasses, holding about four ounces, which must be scrupulously clean, and, if in frequent use, are best kept in a closed vessel of water, since thereby dust is prevented from accumulating at the bottom; and it is well to pour a little strong nitric acid into such glasses occasionally, to effectually remove all dust and deposits, subsequently, of course, thoroughly washing them in cold water. The urine should be allowed to stand six or eight hours at least in a cool place, and be covered by a plate of glass or a paper cap, to prevent the entrance of dust. With a clean glass pipette a few drops of the lowest portion of the fluid may be removed. A collecting-glass has been invented whereby the lower strata of urine may be drawn off from the bottom by a tap; but a pipette answers all ordinary purposes. It is convenient to have the glass slide to which the drops are transferred provided with a cell, made by a very thin circle of gold size, since not infrequently large casts are crushed by the pressure of the cover-glass. The cell also answers the purpose of confining the fluid, any excess of which can be removed with blotting-paper. Such an arrangement is not suitable when it is required to add any reagents to the specimen.

The following objects may occur, the clinical significance of which is treated of elsewhere:—

1. *Adventitious matter, dust, &c.*—Even with the greatest care in collecting and preparation, foreign bodies are extremely apt to be met with, the commonest of which are hairs, wool, cotton and flax fibres, minute particles of feathers or wood, starch-granules, sand, and oil-globules. Besides these, a number of extraneous substances may occur, such as sputum and fæces, the source of which is obvious, whilst occasionally substances are purposely added by malingerers

or by others for the purpose of deceit. It is absolutely essential that an acquaintance with the microscopic appearance of such objects should be possessed by the medical man.

2. *Mucus.*—This material presents itself as finely granular streaks and smears of every variety of size and shape, often mistaken for casts, and occasionally simulated by scratches on the slide or cover-glass.

3. *Epithelial cells.*—These may be derived from all parts of the urinary tract; and they include glandular spheroidal or polyhedral cells, from the kidney, especially the convoluted tubules; columnar cells from the ureter and the greater portion of the urethra; and flattened tesselated scales from the pelvis of the kidneys, and the orifice of the urethra. Very large polygonal cells of the same variety come from the vagina. The vesical epithelium is very variable in appearance, but is generally either flattened or pyriform, of large size, and not always to be distinguished from the scales from other parts.

4. *Spermatozoa.*—Spermatozoa occasionally occur in the urine, without being of serious importance. Their characteristic appearance is not easily recognised under a magnifying power of less than 300 diameters.

5. *Blood.*—Blood-corpuscles in the urine differ considerably from their normal biconcave disc shape, and may shrink into irregularly shaped particles, but usually they swell up and become globular in appearance, these changes being due to alterations in the density of the fluid. Under such circumstances the corpuscles are not very easy of detection, appearing as very faint yellowish rings, and if but very few in number may not always be recognised with certainty, especially as there are many other objects, such as spores of fungi, which closely resemble them. If the blood be present in moderate quantity, it gives a characteristic colour to the urine, which suggests the presence of corpuscles. The discs more rapidly disappear in alkaline than acid urine, remaining in the latter for a considerable time.

6. *Leucocytes.*—Bodies identical with white blood-corpuscles are sometimes seen entangled in the shreds of mucus (mucous corpuscles), or may be derived from the inflamed epithelial surface; and, if present in large amount, constitute pus-corpuscles, originating from pyelitis, cystitis, urethritis, leucorrhœa, rupture of an abscess into the urinary tract, and other conditions.

7. *Portions of new-growths.*—Cells, fibres, and other elements, from cancerous and other neoplasms of the urinary organs or adjacent structures, such as the uterus and the rectum, may be detected in the urine; but it is very seldom that the diagnosis of the existence of these new-growths rests upon their recognition under such circumstances.

8. *Renal tube-casts.*—The appearances, nature, and origin of these bodies have been fully treated of in the article Casts.

9. *Living organisms.*—Perfectly fresh, healthy urine should be quite free from living organisms, but very shortly after being passed various forms are liable to be met with, to some of which the alkaline decomposition of the fluid is due. Among the species which gain entrance to the urine after it is voided, and are to be found in almost all specimens after a few hours unless special precautions be taken to exclude them, are various cocci, of which Micrococcus ureæ (the determining cause of the ammoniacal fermentation of the urea) and Sarcina ureæ are the most abundant, together with numerous bacteria and bacilli, all belonging to the Schizomycetes or fission fungi. In saccharine urine yeast fungi (Saccharomyces or Torula cerevisiæ) are very quickly and abundantly developed; and in stale diabetic urine after the alcoholic fermentation has ceased members of the group of Hyphomycetes or Moulds are to be found—*e.g.* Pœnicillium glaucum and species of Mucor. Certain animal forms, infusoria and amœbæ similar to those occurring in the fæces, have been exceptionally found in urine which has become alkaline after being some time passed.

Micro-organisms and other parasites which are seen in urine as it comes from the bladder are usually of serious import. They may have been introduced *ab extra*, as by a catheter causing the urine to decompose in the bladder, or may have escaped into the urinary passages as the sequence of specific affections of the organs, and of these the tubercle bacillus is the most characteristic. Other forms have been reported as occurring in the urine in nephritis, ulcerative endocarditis, and typhoid fever. Certain entozoa are occasionally found in the urine, the most important of which are the Filaria sanguinis hominis and the eggs of Bilharzia hæmotobia. Hooklets and fragments of echinococci from rupture of hydatid cysts into the urinary passages may sometimes be detected in the urine.

10. *Fat.*—In the condition known as chyluria, large quantities of fat in a state of fine molecules and minute globules, with a few leucocytes, red blood-corpuscles, and frequently embryos of the filaria, are seen by the aid of the microscope. In extreme fatty degeneration of the kidney, as from phosphorus poisoning, fat-granules may be detected in the urine. The possible presence of oil-globules in the urine after the passage of a catheter should be remembered.

11. *Salts.*—The solid constituents of the urine, which are normally held in solution, are apt to be deposited as the result of definite disease, or may occur in association with states on the border-land between it and health, or may be entirely due to fermentative

changes in the secretion after it has been voided.

These various precipitates may be grouped as amorphous, colloidal, and crystalline, either separately or mixed, and for the most part are sufficiently abundant to be recognised by the naked eye, requiring, however, the microscope for their complete recognition.

(i) *Amorphous.*—As a concentrated acid urine cools after being passed there will probably be thrown down a granular deposit, ranging in tint from a faint pink or cream colour to a deep red, the well-known 'brick-dust' precipitate of *urates*—quadrurates of Bence-Jones and Roberts—of sodium, potassium, and ammonium, and occasionally of calcium and magnesium. The coloration of these substances is owing to their association with the urinary pigments. Later, during the 'alkaline fermentation' a white deposit falls of *tribasic calcic phosphate*, which may also be thrown down in acid urine. Under the microscope, these bodies appear as shapeless granules in masses, with no distinctive appearances except as regards colour—not always absolute—and the solubility of the urates on applying heat, which does not dissolve the phosphates.

(ii) *Colloidal.*—Under certain as yet unascertained physical conditions—but of which some degree of viscidity appears to be one—the urinary solids tend to deposit in spheroidal, ovoid, or dumb-bell form, which, falling short of the definite regularity of crystals, are known as submorphous or colloidal. The most frequent salt thus to occur is the calcic oxalate as well-marked dumb-bells in acid urine; much less commonly the calcic sulphate; also in acid urine, and the calcic carbonate, both as dumb-bells and spheres, in an alkaline fluid. Mere microscopic examinations may be insufficient to distinguish these substances from one another; and their behaviour to reagents, such as the solubility of the first mentioned and the insolubility of the second in strong hydrochloric acid, the solubility of the carbonate and the insolubility of the oxalate in acetic acid, must be ascertained. Sodium and ammonium urates may occur in alkaline urine as spheres or ovoids, rarely as dumb-bells, and sometimes as spiny spheroids, the so-called 'hedgehog crystals.'

(iii) *Crystalline.* — *Uric acid*, which in excess forms cayenne-pepper-like grains, or gravel, is remarkably variable in the crystalline shapes it assumes when deposited from acid urine; typically occurring as hexagonal plates and four-sided rhombs, but often ovoid, lozenge, barrel, or comb shaped, singly or aggregated into irregular or rosette-like masses, and of the greatest diversity in size. Owing to the affinity of the urinary pigments for uric acid and its salts, such crystals are always slightly tinted—straw-colour to pale brown, but are colourless when chemically pure. Further characteristics of these crystals are their solubility in liquor potassæ, and the purple colour which they give on the addition of ammonia after evaporating with nitric acid (the murexide test).

Calcic oxalate, found also in acid urine, especially after the ingestion of rhubarb, tomatoes, and certain other articles of food, occurs as octahedra composed of two four-sided pyramids placed base to base, appearing when seen in the short diameter as a square marked by two bright cross lines; they are soluble in mineral acids, but unaffected by heat, acetic acid, or liquor potassæ.

Ammonio-magnesium or *triple phosphates* are deposited in alkaline or very faintly acid urine as triangular prisms with bevelled ends, of varying lengths; when very short simulating the oxalate of lime octahedra, and when long known as the 'coffin lid' or 'knife rest' form. Stellate feathery crystals of the same substance have been seen.

Neutral calcic phosphate occurs as prismatic or wedge-shaped crystals arranged in very characteristic rosettes. Rhombic tablets of basic magnesium phosphate are very occasionally met with.

Calcium sulphate, of very rare occurrence, appears as long needles.

Hippuric acid, also of very exceptional occurrence in human urine, assumes the form of four-sided prisms.

12. *Exceptional substances.* — *Cystin* forms regular hexagonal tablets of various size, which are usually laid one on the other; much less often it appears as square prisms.

Leucin as it occurs in the urine is impure, and appears as yellowish highly refracting spheres, almost like oil-globules and tending to aggregate. *See* LEUCIN.

Tyrosin, which usually accompanies the preceding, forms tufts of very fine needles.

Hæmatoidin, derived from the hæmoglobin and associated with the escape of blood into the urinary tract, has been found as minute yellow or reddish acicular crystals.

Indigo has been seen in decomposing urine, both as blue needle-shaped crystals and as amorphous granules.

For the simple detection of most of the above-mentioned objects no reagents are necessary; but the more transparent bodies, such as casts and epithelial cells, are often rendered easier of detection by slightly tinting the field with a drop of magenta solution or tincture of iodine. The crystalline deposits may be preserved by mounting in Canada balsam or Farrant's medium, subsequent to washing in spirit and turpentine; but attempts to keep for any time either casts, or epithelium, are usually very unsatisfactory, though occasionally successful in very weak carbolised glycerine solution.

(B) **Fæces.**—It is not often that the matters passed by the bowel are submitted

to microscopic examination—not so often perhaps as they should be. The greater bulk of the motions appears to consist microscopically of amorphous granular substance of no special character, consisting for the most part of dead epithelial cells shed from the mucous membrane, and masses of semi-digested proteid and other matters.

The distinctly recognisable objects are :

(α) Those derived from the food-constituents which have escaped digestion or are indigestible, and obviously vary considerably with the diet. Such are starch-granules and shreds of vegetable-tissue, both cells and fibres; oil-globules, elastic and muscular fibres—the latter exhibiting but faint indications of striation, and filaments of areolar tissue. An excessive proportion of any of these, making due allowance for the character of the diet, would suggest some flaw in their digestion demanding investigation. All occur to some extent in normal fæces, and, like most of the constituents, are more or less bile-stained.

(β) Certain crystalline substances are frequently to be found; some are food-derivatives, and unless in abundance are to be regarded as normal, whilst others are of pathological significance. Among the former are acicular crystals, commonly aggregated in tufts, of the higher fatty acids in combination with calcium and magnesium. Occurring in all fæces, they are specially abundant when the bile is excluded from the intestine, or when there is a large amount of fat in the food, as in a milk diet. Crystals of cholesterin are rarely seen in the stools, and leucin and tyrosin probably not at all. Calcic salts, of which the oxalate is the most frequent, but also the phosphate, and occasionally the carbonate, sulphate, and lactate, are seen, presenting the same microscopic appearance of crystalline and colloid form described in the preceding section. Their significance is uncertain, but some at least appear to be more abundant in catarrhal states of the bowel; and the same may be said in respect to crystals of the triple or ammonio-magnesian phosphate which are frequently met with in fluid stools. Hæmatoidin crystals in the fæces are to be considered of morbid import, occurring as they do in association with gastro-intestinal hæmorrhage; and the Charcot-Leyden crystals, similar to those found in sputum, are of occasional occurrence in the stools of typhoid fever and phthisis.

(γ) Among the tissue-elements derived from the gastro-intestinal tract which are found in the evacuations, epithelium cells—columnar and goblet cells—are always present, having all appearances from characteristic individual cells but slightly altered, such as are shed in catarrh, to shrunken and degenerated cells singly, or amorphous masses. They are frequently yellowish from bile-staining. Red blood-corpuscles and leucocytes are seldom seen, the former being rapidly disintegrated among the fæcal matters, and the latter only being appreciably present when there is ulceration of the bowel, or an abscess has burst into the canal. When the corpuscles cannot be recognised, blood may be detected by the hæmin crystals, which form after heating a fragment of the dried fæces, with a grain or two of chloride of sodium, in a few drops of glacial acetic acid.

(δ) The numerous living organisms, vegetable and animal, which, infesting the intestines, may be found in the fæces, are enumerated and described in the articles, Intestines, Diseases of: 17. Micro-organisms of; and 20. Parasites of. For the detection of the various bacilli, the film of fæcal matter dried on the cover-glass should be soaked for some time in solutions of the appropriate dyes, such as methylene blue, fuchsin, &c. *See* Micro-organisms.

To investigate these, it is merely sufficient to flatten out, by means of slight pressure on the cover-glass, a small portion of the motion, in a drop of some indifferent medium, such as a 1 per cent. saline solution or very dilute glycerine. The micro-organisms are best examined as 'cover-glass preparations,' as described above and in Section D on the Sputum; or in some of the sediment removed by a pipette, after a small portion of the fæcal matter has been shaken up with a large excess of distilled water, and allowed to stand.

(C) **Vomit.**—This should be examined as soon as possible after expulsion, and the liability to the presence of all kinds of extraneous matter should be borne in mind. Small portions may be spread out in dilute glycerine; or it may be necessary to shake up the matter with distilled water, and take up a few drops of the mixture with a pipette.

As in the fæces, the ejected contents of the stomach consist microscopically of masses and flakes of material presenting no morphological characters, as well as food-particles in varying stages of digestive disintegration, with consequent loss of distinctive features. It is impossible to give any accurate description of these substances, but those which are to be recognised with more or less certainty are fat globules, muscular, elastic, and areolar tissue fibres, starch-granules, and shreds of vegetable tissue. Epithelial cells, both squamous and columnar, and occasional red and white blood-corpuscles, may also be detected. The micro-organisms are very variable, but on the whole are less numerous than in the intestines, the acid medium of the stomach being less favourable to their development; and it is more particularly when the food is unduly delayed in the stomach, as in gastro-ectasis, that they are to be found. Several species of yeast fungi,

which cause the various fermentations of carbohydrates, producing alcohol, lactic and butyric acids, &c., are perhaps the most abundant, although micrococci, bacilli, and sarcinæ are to be met with, especially the last named. Fragments of new-growths, cancer-cells, &c., are occasionally seen.

(D) **Sputum.**—In the examination of the expectoration the microscope is often of great value, as thereby the exact nature of the morbid changes in the lungs may be determined. Small shreds of the sputum should be separated and spread out on the slide, and covered at once; sometimes a drop of a watery solution of methylene blue is required to render more evident some of the very transparent objects. It is obvious that the expectoration is liable to contain all kinds of objects that have not come from the lungs—fragments of food, epithelial scales from the tongue and mouth, hairs, &c.; but, excluding all such bodies, the sputum consists of a menstruum of viscid mucus, which is hardly recognisable under the microscope, except as a very finely granular film, entangled in which are innumerable air-bubbles of all sizes, with a few *leucocytes*, and occasionally a few squamous and more or less distinctly ciliated *epithelium cells* from the air-passages. If a drop of acetic acid be floated in beneath the cover-glass, the mucus assumes a finely striated appearance, and the nuclei of the cells are rendered very distinct. With all degrees of catarrh and inflammation of the mucous tract the number of leucocytes and epithelial cells becomes more and more abundant, with occasional *red blood-corpuscles*, which increase in proportion to the degree of pulmonary hæmorrhage, and oil-globules liberated from cells that have undergone fatty degeneration. When the lung is actually breaking down, fragments of pulmonary tissue may be readily recognised under the microscope by the characteristic elastic fibres, which frequently retain the arrangement they normally have in the walls of the air-cells. They are rendered especially distinct by the addition of acetic acid, or by previously boiling the sputum for a short time with solution of caustic soda (20 grains to the ounce), which clears up other matter, leaving the elastic tissue untouched. Vegetable fibres derived from the food, and which also resist the action of the alkali, must not be mistaken for the lung-tissue. Fibres of connective tissue, and particles of cartilage from the bronchi, may occasionally be detected in destructive lung-disease.

Besides the above-mentioned epithelium, there are occasionally to be seen flattened tesselated scales, with large nuclei, derived from the alveoli of the lungs, and more frequently spheroidal or elliptical nucleated cells, also supposed to come from the alveoli. These often contain granules of pigment, or of soot or metallic dusts which have been inhaled, or their granular protoplasm may be almost completely replaced by fat granules and globules. Their real significance is uncertain, but they are surely pathological. Microscopic fibrinous casts of the ultimate bronchioles and air-vesicles are seen in the sputa of acute pneumonia, and in the condition known as plastic bronchitis. *See* CASTS.

Apparently associated with pulmonary hæmorrhage, may be seen in the expectoration objects somewhat resembling starch-granules—*corpora amylacea*—though it is doubtful whether they are really amyloid in composition. In the sputum of asthma and capillary bronchitis, and less often of pneumonia, peculiar spiral bodies are sometimes seen even with the naked eye, and frequently of considerable length; they would seem to be composed of mucin or some similar substance, and are known as *Curschmann's spirals.* Epithelial cells are apt to be entangled among the finer fibrils which twist around the central spiral thread of which they are composed.

Various crystals may be found in the sputum in disease, and those termed Charcot-Leyden crystals are the most peculiar. Occurring in the expectoration of an asthmatic paroxysm, and also in bronchitis, they appear as colourless elongated flattened octahedra, very variable in size, and soluble in warm water, mineral and acetic acids, and alkalis, but insoluble in cold water, alcohol, and chloroform. Their exact nature and composition are unknown, but they are probably derived from the epithelial cells of the bronchioles. Crystals of hæmatoidin, indicative of previous hæmorrhage into the air-passages, with subsequent decomposition of the blood; of cholesterin and salts of the fatty acids, showing caseous degeneration of inflammatory products; also leucin and tyrosin, and occasionally oxalate of calcium, and ammonio-magnesium phosphate—all these may be seen, but are of no great diagnostic value.

The examination of the sputum for micro-organisms, especially the bacillus tuberculosis, has become a matter of routine, and affords valuable diagnostic information. Among the various methods of procedure which have been recommended, the following is here selected as a convenient example of the 'cover-glass preparation.'

Take up with forceps the cover-glass, the sputum-layer being uppermost, and drop thereon with a pipette just enough of solution *a* (*see* formula 7, p. 1350) to form a complete layer, and heat it over a spirit-lamp flame until it *begins* to boil. Then, having thrown off the staining solution, press the cover-glass lightly between two folds of filter-paper. Next immerse the red-stained cover-glass in solution *b* for a few seconds. This done, wash it in water to neutralise the acid. The sputum-layer should now be of a pale blue tint (if any red remain the process must

be repeated). The cover-glass should then be dried on blotting-paper, and finally dehydrated by waving it to and fro a few times through the spirit-lamp flame. The preparation is finished by mounting it in balsam. The time required for preparing, staining, and demonstrating tubercle bacilli in sputum by this method need not be longer than three minutes.

Besides the tubercle bacillus, the diplococci of pneumonia and (though rarely) actinomycosis and species of protozoa, are to be found. Fragments of echinococcus cyst and hooklets, as well as the ova of Bilharzia hæmatobium, may be detected.

(E) Blood.—The microscopic examination of the blood is concerned with (*a*) the formed elements of that fluid, and (*b*) foreign bodies which may have been developed in it or have gained entrance to the stream.

(*a*) As regards the former, the red and white corpuscles and blood-plates, they may be altered in quantity or in character. The method of enumeration of the corpuscles is elsewhere described (*see* HÆMACYTOMETER); by it are detected the conditions known as polycythæmia (excess of red corpuscles) and oligocythæmia (deficiency of the same), leucocythæmia or leukæmia (permanent excess of white corpuscles) and leucocytosis (a transient excess in their number). Variations in the number of blood-plates are less easily detected, and the significance of such is imperfectly known, but an excess has been noted in pregnancy and some chronic maladies, whilst in fever they are said to be fewer; but it cannot be said that their normal proportion to the other corpuscles has been accurately determined. *See* BLOOD, Morbid Conditions of.

Much care is required for the proper interpretation of the changes observed in the appearance of the corpuscles, since these elements, especially the red, are very susceptible of alterations of form determined by an increased or diminished density of the plasma, tending to swell up and lose their biconcavity or to become crenated or even stellate. Some of these changes may take place after the blood has been drawn from the body, due to want of proper precautions in maintaining the normal conditions, or are even wholly *post-mortem* effects. Apart from these accidental alterations, very definite differences from the standard size of the corpuscles have been noted, varying from a third (*microcytes*) to double that of the normal diameter (*macrocytes*). These varieties may be of very temporary duration, and their explanation is unknown; but they are more prone to occur in such blood-states as chlorosis and pernicious anæmia, in certain toxic conditions, and in burns. More noticeable are extreme alterations in the shape of the red corpuscles; seen at the maximum in pernicious anæmia, though also met with in severe chlorosis or other cachectic states, as the cancerous. In place of the normal flattened discs the corpuscles may be oval, tailed, reniform, or of irregular contour, perhaps to be attributed to an exaggerated protoplasmic contractility: to this condition the term *poikilocytosis* is applied. Nucleated cells tinged with hæmoglobin, and representing intermediate stages between the red and white corpuscles, are to be found in such profound blood-affections as leukæmia. Structural perversions of the leucocytes recognisable by the microscope refer chiefly to the behaviour of these bodies with staining agents, particularly eosin, as well as considerable differences in their size. Attempts have been made, though of doubtful certainty, to distinguish between the various forms of leukæmia, and between these affections and Hodgkin's disease, by the differences in the extent to which the protoplasmic granules of the leucocytes take the eosin staining. Those cells which exhibit the greatest preference for the dye are termed 'eosinophile,' and are supposed to indicate in proportion to their number a true leukæmia rather than a temporary leucocytosis. But identical cells have been found in conditions quite apart from leukæmia, and their diagnostic value is very uncertain. As is well known, the red corpuscles of healthy blood after being shed tend to run into rouleaux; but in some diseases no such tendency is observed, and the cells remain entirely separate or aggregated into irregular heaps.

(*b*) Among the adventitious bodies found in the blood are pigment-granules and masses, often free but sometimes included in the white corpuscles, and constituting the condition known as *melanæmia*, as seen in severe intermittent and remittent fevers. Colourless octohedral crystals, similar to if not identical with those described in the previous section as Charcot-Leyden crystals, have been said to occur in leukæmic blood, but it is doubtful whether they are not due to *post-mortem* change.

The most important objects of this group are wholly extraneous in origin, namely, parasites, both micro-organisms and members of the class Vermes. To the former belong the bacillus of tubercle, anthrax, glanders, typhoid fever, malarial fever, the streptococci of crysipelas, and spirillum of relapsing fever—all described elsewhere. The two higher hæmatozoa, namely, Distoma hæmatobium, ova and perfect worm, and Filaria sanguinishominis, are also fully treated of under other headings.

To examine blood, the finger, having been carefully cleansed, should be pricked in its extensor aspect with a lancet-needle without being squeezed or constricted by ligature, &c. The cover-glass should be just touched at its centre with the blood-drop, and then pressed very lightly on the slide, so that a thin and uniform layer is obtained. It is of the

greatest importance that the slide and cover-glass should be perfectly clean, for otherwise crenation sets in very rapidly. A ring of some indifferent oleaginous material, such as thin vaseline, applied round the edge of the cover-glass will prevent evaporation, and keep the blood fresh for many hours. For the examination of fresh blood this is sufficient, but for permanent preparations the following technique is advisable. Expose the cover-glasses with their thin films of blood to the vapour of 1 to 2 per cent. osmic acid for some minutes. Then dry them thoroughly by placing them in front of a good fire carefully protected (*e.g.* under a watch-glass) from dust, &c. They may then be stained by floating them in an aqueous solution of fuchsin, or of phenol-fuchsin (*see* formula 7), and then contrast stained with alkaline methylene blue (*see* formula 4). Other good second stains are phenol-methylene blue, phenol-iodine green (made up like phenol-fuchsin), anilin oil, or gentian violet. The red corpuscles pick up the red dye, and the leucocytes the blue or green. In any case the blood-plates will be stained, though they are best seen if the cover-glass be treated by Gram's method. Eosin is frequently used for staining blood films, and a convenient formula is eosin (soluble in water) 1 grm., alcohol 60 c.c., water 160 c.c. When the cover-glasses are sufficiently stained they may, after removing the superfluous fluid with bibulous paper, be dried in the flame and mounted, but it is better to pass them through absolute alcohol very quickly, then mop up on filter paper, pass through flame, and mount in balsam. A similar method of using various dyes is suitable for the demonstration of micro-organisms in the blood.

(F) **Milk.**—A drop of milk, placed on a slide and covered with a thin glass, discloses on examination fatty granules and globules of all sizes, with sharply defined outlines, and kept separate from one another by surrounding invisible films of proteid matter. In the milk secreted immediately before and immediately after delivery will be seen colostrum corpuscles, and a few leucocytes and occasional epithelial cells. Pathogenic bacilli, of which bacillus tuberculosis is the most important, have been demonstrated in milk.

(G) **Morbid Discharges.**—The microscope is frequently of value in examining discharges from surfaces—for instance, in leucorrhœa; or from abscesses which may have burst. In the latter cases, besides the pus-cells, fragments of tissue may be seen, indicating the situation of the abscess; or the existence of a new-growth may be manifested by finding small portions in the discharge. Vaginal secretions, especially in catarrhal states, in addition to numerous leucocytes, are apt to contain an infusorian, the *Trichomonas vaginalis*, an oval-tailed animalcule of about the size of a white blood-corpuscle provided with flagella and cilia; micrococci are usually abundant. The microscopic objects in the seminal fluid are the spermatozoa, which may be deficient in number, the seminal cells from which they are developed, squamous and columnar epithelial cells, and occasionally red blood-corpuscles, leucocytes, and Charcot-Leyden crystals, the last-named being probably only formed after the preparation has stood some hours.

The different morbid exudations from serous surfaces exhibit leucocytes and red blood-corpuscles, fatty granules, and crystals of hæmatoidin, cholesterin, and fats in varying abundance. Certain micro-organisms which invariably accompany suppuration, namely, micrococci, as well as bacilli of tubercle, and also actinomycosis, may be demonstrated by cover-glass preparations as above described.

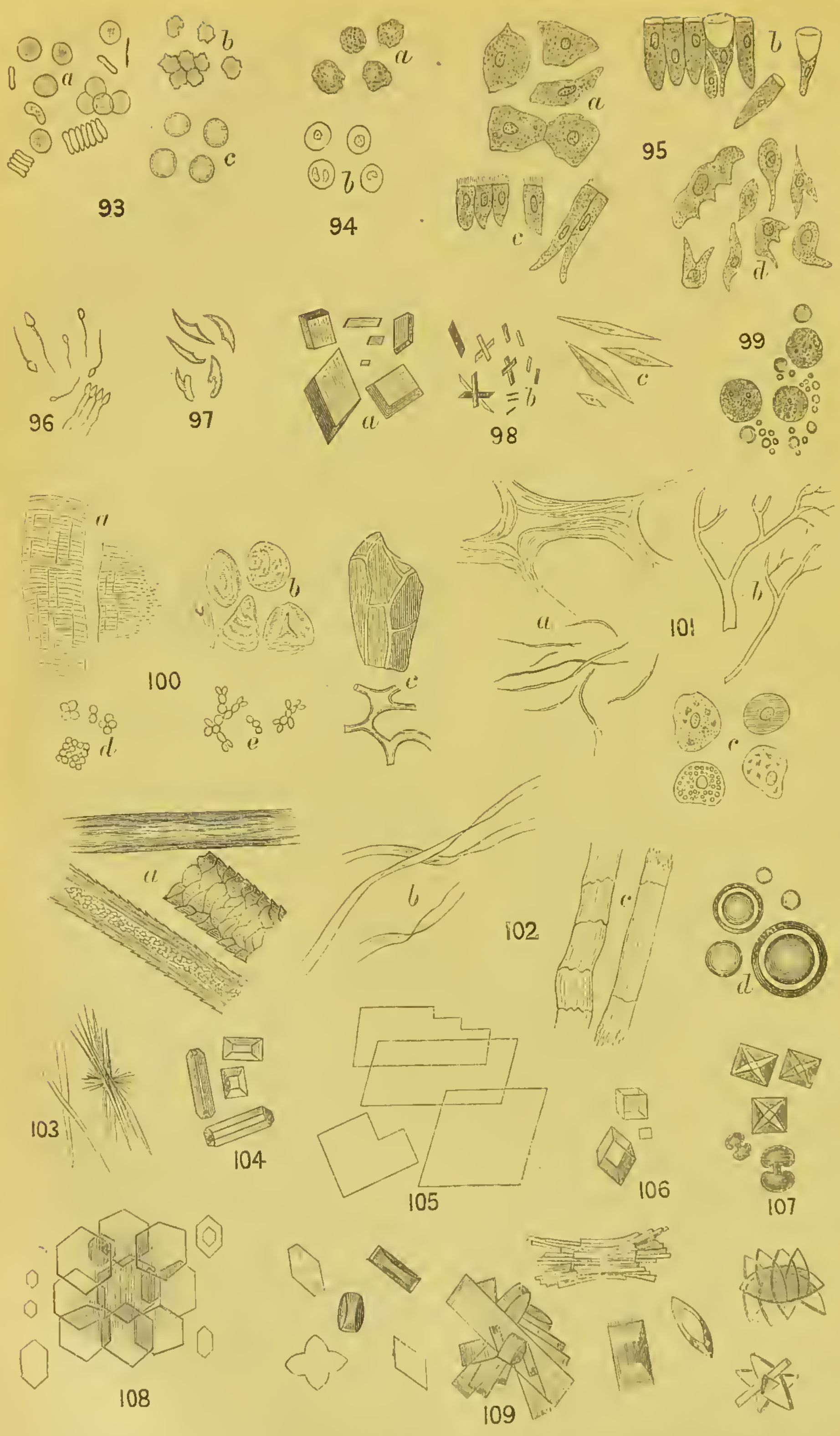
(H) **Contents of Cysts.**—These are for the most part fluid or gelatinous, and leave very little for microscopic examination, besides a varying number of red and white blood-corpuscles and epithelial cells of various kinds. Exception must be made to the echinococcus hooklets of hydatid cysts, the hairs of dermoid cysts, the fatty matter of sebaceous cysts, and cholesterine crystals, so commonly met with in ovarian, and indeed in all forms of cysts.

(I) **New-Growths.**—The microscopical characters of tumours are fully described under the heads of CANCER and TUMOURS.

(K) **Parasites.**—The value of the microscope for the detection of micro-organisms in the different situations in which they occur has been already referred to. Scarcely less useful is the instrument for the recognition of the various species of Tinea and Pediculi which infest the skin and hairs. *See* EPIPHYTIC SKIN-DISEASES.

(L) **Adulterations of Food, Drugs, &c.**—By means of the microscope many impurities and adulterations may be discovered, which would otherwise remain unrecognised. The following substances which are extensively used are at once detected under the microscope, and many of them in this way only—namely, starch of various kinds, improperly added to cocoa and mustard; leaves of willow or plum, substituted for tea; chicory, a root of a species of dandelion, mixed with coffee; sand with sugar; red lead with cayenne pepper; and many pigments—indigo, venetian red, umber, turmeric; as well as different salts, sulphate and carbonate of lime.

(M) **Medico-Legal Inquiries.**—Stains of blood, semen, &c. on clothing should be moistened with a few drops of distilled water or, better still, a ½ per cent. solution of chloride of sodium, and scraped with a sharp knife; and the fluid then transferred to a glass slide, and examined in the usual



Drawings illustrating Common Objects seen with the Microscope in Medicine.

manner. The microscopical characters of spermatozoa and blood have been already referred to.

DESCRIPTION OF FIGURES.

Fig. 93.—Red blood-corpuscles—human.
a. Normal, singly and in rouleaux. *b.* Crenated and shrunk from drying or treatment with a concentrated fluid. *c.* Distended and globular from absorption of water.

Fig. 94.—Leucocytes. Pus, mucous or white blood-corpuscles.
a. Normal. *b.* After treatment with acetic acid; nuclei very distinct.

Fig. 95.—Epithelial cells.
a. Scaly, from mouth, vagina, &c. *b.* Columnar and goblet, from gastro-intestinal canal. *c.* Ciliated, from air-passages. *d.* Irregular and transitional forms from urinary tract.

Fig. 96.—Spermatozoa.

Fig. 97.—Hooklets of echinococcus.

Fig. 98.—Crystals.
a. Hæmatoidin. *b.* Hæmin. *c.* Charcot-Leyden crystals.

Fig. 99.—Milk.
a. Colostrum-corpuscles. *b.* Oil-globules, very variable in size, and with sharply defined outline.

Fig. 100.—Objects seen in vomited matter.
a. Muscle-fibres partially digested. *b.* Starch-granules, some showing the characteristic concentric marking, others broken up by digestion. *c.* Fragments of vegetable-tissue. *d.* Sarcinæ. *e.* Torulæ.

Fig. 101.—Objects seen in sputum.
a. Elastic fibres from the lung-tissue. *b.* Minute fibrinous coagula occurring in acute pneumonia. *c.* Alveolar epithelium.

Fig. 102.—Adventitious objects.
a. Hairs, showing cortex, epidermis, and medulla. *b.* Cotton-fibres, showing characteristic twist. *c.* Linen-fibres. *d.* Air-bubbles in varying focus.

Fig. 103.—Tyrosin; needles.

Fig. 104.—Triple or ammonio-magnesium phosphates.

Fig. 105.—Cholesterin; plates.

Fig. 106.—Chloride of sodium; cubes.

Fig. 107.—Oxalate of calcium; dumb-bells and octahedra.

Fig. 108.—Cystin.

Fig. 109.—Uric acid; various forms.

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MICROSPORON (μικρός, small; and σπόρος, a spore).—*Microsporon furfur* is the fungus of tinea versicolor, and *Microsporon minutissimum* of erythrasma. *See* EPIPHYTIC SKIN-DISEASES; and ERYTHRASMA.

MICTURITION, Disorders of.—Under this term will be considered those conditions which interfere with the normal performance of micturition, regarded as a physical act. Thus suppression of urine is not included in this category, for in the state so described no urine is secreted by the kidney, and the absence of the secretion is not due to any physical cause in the bladder or urethra. The following will be treated of as disorders of micturition:—

1. *Irritability of the bladder in the adult.*
2. *Diminished size of stream.*
3. *Retention of urine, partial* and *complete.*
4. *Urine passing by an abnormal channel.*
5. *Incontinence and overflow of urine in the adult.*
6. *Incontinence of urine in the child.*

1. *Irritability of the bladder.*—This term is never to be employed as defining any morbid condition of the bladder, since it is too vague to denote anything else than a symptom, of which the practitioner has to discover the cause. It is commonly used in widely differing senses, and conveys therefore no definite meaning to the hearer. As denoting a symptom, it may be held to imply the simple fact of unduly frequent micturition, and should never be used, either in writing or otherwise, in any other sense. Whenever, therefore, this phenomenon is present, instead of regarding it as due to some specific morbid state, indicated by the term 'irritability of the bladder,' as too frequently happens, the problem to be solved is What is the cause of the irritability? In all maladies of the bladder, and in most that affect the kidney also, unnaturally frequent micturition is present. It may vary in degree, and exist alone as a single symptom; or it may, as is much more usually the case, be accompanied by other symptoms, which aid the diagnosis. Thus it is present in all the inflammatory conditions of the bladder, and whenever calculi, foreign bodies, or tumours exist there. Also when the bladder is full, and either habitually does not empty itself, or when absolute retention is present, in either case the wants to pass water are frequent and pressing. It is often present in stricture of the urethra, and in inflammations of that passage; also in chronic pyelitis, simple or calculous, in chronic nephritis, in Bright's disease, in diabetes mellitus, as a result of the increased quantity of urine, or when urine is morbidly acid. It is present likewise during hysterical states, and under emotional excitements in many persons of either sex; and whenever the watery elements of the urine are rapidly and abundantly secreted.

2. *Diminished size of stream.*—This may occur either with or without organic obstruction in the passage. It is always present, of course, in congenital narrowing of the prepuce or of the external meatus; in organic stricture of the urethra; and mostly in enlarged prostate. It may be occasioned by inflammation of the urethra and prostate; and by impaired power in the bladder to expel its contents, from partial paralysis, atony, or other cause. Occasionally the channel is narrowed by irregular actions of the surrounding muscles, and thus 'spasmodic stricture' (an objectionable term) is spoken of as producing a diminution of the stream.

3. *Retention of urine.*—Retention of urine, partial or complete, is not to be confounded

with 'suppression,' the latter being of course defective action of the secreting organ, so that no urine is produced, and the bladder remains empty. Retention is the result in almost all cases of mechanical obstruction, such as enlarged prostate from hypertrophy, tumour, presence of blood-clots in the urethra or bladder, and occasionally from rupture of that organ. One of its most common causes is a narrow stricture of the urethra, especially when inflammation follows the use of instruments; inflammation alone may also occasion retention, as during an attack of gonorrhœa. Impacted calculus is not infrequently the cause; sometimes also, but most rarely, the spasmodic action referred to above.

Treatment.—As the cause is a purely mechanical one in the great majority of instances, the remedy which should be applied without delay is also a mechanical one, namely, a catheter of appropriate size and kind. If a suitable instrument, however, is not within reach, medicinal agents may be of service until it can be obtained. At the head of these no doubt is opium, which allays involuntary straining, and sometimes thus enables the patient to relieve himself by the natural method, at all events to some extent. It should be given in full doses, for the purpose either of relieving the patient's suffering and anxiety, or of acting favourably on the function; and the error in practice which has been most common is to give doses of 10 to 15 minims of laudanum or liquor opii, when 30 to 40 or more were necessary, and might have been highly useful. Of course the form of opiate may be varied, according to the habits of the patient or the views of the attendant. Simple opium is merely mentioned here as the type. Local bathing, as hot as it can be borne, is also a valuable adjunct; as, for example, a hip-bath, commencing at 100° F., which may with advantage be carried gradually up to 110° in these circumstances. Diuretics, often given, are for the most part injurious; that is to say, when the cause is a mechanical one; the same must be said, in such circumstances, of the tincture of the perchloride of iron, once in some repute in retention of urine. As a general principle, also, it is not to be forgotten that active purgation commonly promotes the expulsive action of the bladder, often materially so, and tends to afford relief.

4. *Urine passing by abnormal passages.*—The urine may escape by abnormal channels, passing from different parts of the urethra to the surface, most commonly by that of the perinæum, constituting urinary fistula. This condition is necessarily named as one of the 'disorders of micturition,' but its treatment belongs exclusively to the experienced practical surgeon.

5. *Incontinence and overflow of urine in the adult.*—The conditions so denoted here are among those disorders of micturition which it is very important to understand. It not infrequently happens that a man between fifty and sixty years of age finds himself gradually compelled to pass urine oftener than has been his custom hitherto, and that, the tendency still increasing, he is compelled to pass it every hour or two, both by day and night; and sometimes even, especially if not relieved by treatment, he may pass it without his will or knowledge, during sleep. During the earlier stages of the affection, it is by no means uncommon that the individual learns or believes that his experience is natural to age, and is either not amenable to treatment, or is not worthy of serious notice. Many a life has been endangered most certainly, and some have been lost, by such an estimate of these symptoms. Again, the condition described is often loosely spoken of as 'incontinence' of urine; of which, however, it is not only not an example, but indeed indicates the presence of a condition precisely contrary. It is extremely important not to confound these two opposite states when making our diagnosis. What does produce frequent micturition and so-called 'incontinence' in such a case, is a bladder unable to empty itself, always therefore partially if not completely filled, from which the surplus must be either frequently discharged, or be passed 'incontinently.' The important point, then, is never to lose sight of the fact that frequent micturition, and above all urine involuntarily passed by elderly men, in nineteen cases out of twenty indicates retention (requiring the catheter), and not incontinence.

True incontinence, which means inability to retain, on the part of the bladder, is a very rare occurrence, and is present almost invariably only in cases of disease in the nervous centres producing paralysis in other parts of the body, as well as the bladder. When the bladder-symptoms alone are present, and no signs of paralysis elsewhere exist, it may be held as almost absolutely certain that the bladder itself is not paralysed. It may be over-distended with fluid from enlarged prostate; or its coats may be thinned and atonied, and so unable to contract on their contents; but there is no true paralysis of the bladder (commonly as that term is often employed) without central lesions of the kind above referred to, and affecting other functions also besides that of micturition.

Treatment.—In these partial retentions of urine, producing its overflow and involuntary discharge, the remedy consists, in the more or less frequent use, according to circumstances, of a soft or flexible catheter, and the case is mainly surgical. There are some instances in which restoration of the power of the bladder may be attempted by medicinal agents, such as strychnine and iron, or by

electricity, but their effect is little or none, apart from the habitual emptying of the organ by artificial means. In some cases perhaps they may be advantageously associated with the surgical treatment.

6. *Juvenile incontinence.*—A brief sketch of this common and well-known affection is all that our limits will admit. Nevertheless it is one relative to which much might be written, without exhausting a subject the pathology of which has wide and manifold relations.

In the earliest periods of childhood an undue frequency of passing water is often to be observed among individuals of both sexes, more commonly in boys than in girls. As age advances the infirmity usually lessens, and then disappears; whilst in exceptional instances it continues, without change, to puberty, and even for some years after that period has arrived. But the peculiarity of the case is that the urine is passed unconsciously during sleep, and this forms the most serious symptom. In spite of all precautions, a quantity of urine is discharged every night during deep sleep, an occurrence of which the child is quite unaware, and which as he advances in age he is wholly unable to control, however strong may be his disposition to do so. On the bladder becoming distended reflex action of the vesical muscular coats takes place, and the contents are discharged. The flow of urine is determined, as it would appear, not by inability on the part of the bladder to retain the ordinary quantity of urine, for the patient does so by day, but by its undue excitability or readiness to contract, so that the water is passed while consciousness is lost, during sleep. In a few instances, certain aberrations from a good standard of health seem to favour the production of these phenomena, especially sources of irritation in the rectum, which produce activity in that muscular apparatus, involving also the kindred muscles of the bladder, which are so closely associated. Thus the presence of ascarides or other foreign agents may suffice to occasion expulsive action in the bladder. During the period of infancy and early childhood the nervous system is highly impressionable, and the habit in question being accidentally set up, its persistence may result solely from repetition through the force of custom, long after the original cause has disappeared.

Sometimes slight malformations of the male organ favour the occurrence of incontinence; such as a narrow meatus, or a long prepuce which is never retracted and is consequently in an unhealthy state.

Precocious development and extreme activity of the mental faculties, producing disturbed sleep, seem to favour the occurrence of incontinence. On the other hand, it is sometimes associated with a morbid deficiency of intelligence.

Treatment. — The treatment ordinarily necessary may be to some extent inferred, when examination of the patient has determined the presence or absence of the conditions named. This done, the next indication is to subdue the activity of the expulsive function of the bladder by some agent which possesses that power. The most powerful for this purpose is undoubtedly belladonna; one of the most notable qualities of this drug is its temporary influence to produce a paralysed condition of the vesical muscles. Thus, if administered to an adult whose powers of expelling urine are feeble, such, for example, as are commonly met with in advancing years, complete retention of urine is often produced. Of this the writer has seen many marked illustrations. Now, as has already been observed, in not a few of the cases of so-called 'juvenile incontinence,' its existence is due solely to persisting habit after the original occasion of it has long ceased; and these are almost certainly and sometimes rapidly cured by administering the agent in question. The object is to induce a partial paralysis of the bladder for a period of some weeks, and if the case is obstinate, even for two, three, or four months, and by this means not only to destroy the old habit, but to develop a new one, namely, a habit of retention, and the annoyance disappears entirely and for ever. On meeting, therefore, with a case, whether in childhood or youth, the first indication is to correct any manifest deviation from the ordinary standard of general health; and, secondly, to administer belladonna persistently. Small doses, suited to the age of the patient, suffice at first, and may be given every afternoon and evening only—say from six to twelve minims of the tincture on each occasion during the first week. In the second and third weeks of treatment, the dose may be augmented one-fourth; in the fourth and fifth weeks the original dose is raised a third or half; meantime some improvement will almost certainly by this time be manifest. Since the ability to bear belladonna increases rapidly as the system becomes habituated to it, a larger dose may be given during a further term of three successive weeks, by which time the involuntary discharge of urine probably ceases. If not, a gradually increased dose must still be continued. After this the dose may be gradually diminished, and at a rate more rapid than that by which it was augmented: the habit of retention has probably been formed by this time, and when cessation from medicine takes place, no recurrence of the symptoms will be observed. Such is the writer's experience in a considerable proportion of the cases which have fallen in his way. But it must be confessed that a troublesome minority is met with in which the influence of the belladonna has not been permanent. It almost invariably produces

some improvement, however, and it is worth while to be careful that the drug has been well prepared. Thus the writer has been successful with the belladonna of one chemist, after failure with that of others. Now, in regard of these obstinate and exceptional cases, what remains to be done? It may be assumed that an exhaustive observation has been made of all the functions, especially of those which perform digestion, and that it is unnecessary to insist further on this score, or to suggest the numerous details which such consideration gives rise to. All this done, there still remain modes of treatment of a local character, which ultimately almost always prove successful in these cases. These do not include blisters on the sacrum; apparatus to prevent the patient lying on his back, when asleep; arrangements to arouse him during the night once or twice to pass water voluntarily, and such measures—all of which are palliative means, and do little towards a radical cure, and which constituted the chief agencies employed some years ago.

Superior to all these in the writer's hands has been the application of a solution of nitrate of silver to the urethra, whether in the male or female. Even the use of a flexible bougie, small of course for children, passed daily, and removed in the course of a minute or so, is sometimes successful. But if this fails, the injection by means of a sufficiently long tube of the solution named to the prostatic portion of the urethra and neck of the bladder, is a remedy of no mean value. The process generally known to surgeons as 'instillation,' by means of a syringe and a flexible tube, is perhaps the best. For young women up to the age of eighteen or twenty in whom this unfortunate infirmity still exists, the writer has found it almost always, if not invariably, successful. It should be applied immediately after the bladder is emptied, in quantity, say, of a drachm, and of a minimum strength of ten grains to the ounce, up to treble that strength if necessary for subsequent applications. Enough should be employed to produce decided smarting, which shall continue for a day or two. A week or two should be permitted to elapse between each application.

It would not be right to omit the mention of other remedies besides belladonna, which may be used either alone or in combination with it. Such are the tincture of the perchloride of iron; strychnine; tincture of cantharides; and bromide of potassium. The last-mentioned, given at night only, has sometimes a manifestly beneficial effect.

HENRY THOMPSON.

MIDDLE PARK HOT SPRINGS, in Grand County, Colorado, U.S.A.—Thermal waters. *See* MINERAL WATERS.

MIGRAINE.—A synonym for megrim. *See* MEGRIM.

MIGRATION OF CORPUSCLES. The escape of blood-corpuscles through the walls of minute vessels, and their passage into the surrounding tissues. The process is chiefly seen in inflammation. *See* INFLAMMATION.

MILIARIA (*milium*, a millet-seed).—SYNON.: Sudamina; Fr. *Miliaire*; Ger. *Friesel*.

DEFINITION.—A vesicular eruption of the skin, generally associated with profuse sweating, and sometimes with pyrexia.

DESCRIPTION.—The proximate causes of miliaria are heat and sweating. The vesicles have the bulk of millet-seeds; are developed close to the pores of the skin; are generally discrete; and are dispersed irregularly over the surface. They are thin, and contain at first a pellucid fluid; in a more advanced stage they sometimes, though rarely, become inflamed, and then the serum becomes milky and opaque, and the eruption is called *miliaria alba*. When left to themselves the vesicles subside and dry up into an extremely thin scale.

TREATMENT.—The treatment of miliaria consists in subduing whatever feverish symptoms may be present; in lightening the clothing and coverings; in the use of tepid baths and tepid sponging; and, after the bath, dusting the skin with some absorbent powder, such as fuller's earth. Sponging with lime-water is also useful; and the use of a lotion in which oxide of zinc is suspended in lime-water, in the proportion of 40 grains to an ounce. This should be painted on the affected parts of the skin, and allowed to desiccate thereon.

ERASMUS WILSON.

MILIARY ANEURYSMS.—Minute dilatations in connexion with the small blood-vessels; especially met with in the brain. *See* BRAIN, VESSELS OF, Diseases of.

MILIARY FEVER.—A febrile condition attended with the eruption of miliaria. *See* MILIARIA.

MILIARY TUBERCLES. — True tubercles, which appear in the form of minute granulations. *See* TUBERCLE.

MILK FEVER.—SYNON.: Ephemeral Fever; So. Weed; Fr. *Fièvre de Lait*; Ger. *Milchfieber*.

DEFINITION.—A febrile condition produced by constitutional disturbance, accompanying the flow of milk to the breasts, on the third or fourth day after delivery.

ÆTIOLOGY.—The older writers considered a febrile state to be a normal accompaniment of the establishment of the secretion of milk, but since the introduction of the clinical thermometer, and its employment by

nurses as part of the daily routine after labour, it has been shown that functional disturbances in the breasts about this period, sufficient to cause a distinct milk fever, are quite of exceptional occurrence. It appears to arise chiefly in those who are in a feeble state from want of nourishment, loss of blood, or other cause; or to occur when the child has not been put to the breasts sufficiently early to free the milk tubes.

SYMPTOMS.—The symptoms of milk fever are sometimes slight, and pass off very quickly, in which case the term 'ephemeral' is appropriate; but sometimes the fever is considerable, the temperature rising high, perhaps exceeding 102° F., and the pulse beating 120 or more in the minute, from which state the recovery is probably less rapid. The patient generally experiences slight shivering, her teeth chatter, there is a sensation of cold water running down her spine, and she calls for blankets and hot-water bottles. At this time the breasts are swollen and sensitive. This chill soon gives way to a hot stage, which may last from two to twelve hours; the head aches badly; there is pain in the limbs and restlessness, and generally thirst. The breasts now become very painful to the touch, hard, and knotty, the skin tense and shiny, and the superficial veins distended, while the axillary glands are enlarged, and the lymphatics running to them can be felt like cords. Then follows the sweating stage, from which great relief is experienced; the breasts become softer, and milk commences to flow from the nipples; the temperature falls; and all the symptoms abate.

TREATMENT.—During the cold stage the desire of the patient for hot-water bottles and blankets should be gratified; and care should be taken not to diminish the amount of clothing too rapidly during the hot stage. The bowels should be evacuated. A diaphoretic mixture, such as solution of acetate of ammonium with camphor water, should be administered; and the child should be put to the breasts as soon as the sweating stage sets in. In many cases flannels wrung out in hot water applied to the breasts give great relief; and sometimes *very gentle* kneading towards the nipple, using the thumb, with vaseline or warm oil, starts the milk to flow from the nipple, and hastens the subsidence of the symptoms. CLEMENT GODSON.

MIMOSIS (μιμέομαι, I imitate).—A term applied to the phenomena of a disease, which resemble or imitate those of another disease.

MIND, Disorders of.—*See* IDIOCY; and INSANITY.

MINERAL WATERS.—DEFINITION. Mineral Waters is the name given to those waters which, on account of the different saline or gaseous substances which they hold in solution, or of their elevated temperature, are used in the treatment of disease, either internally or in the various forms of baths.

The science that treats of the effects of mineral waters and baths on a great number of chronic maladies is called *Balneotherapeutics.* In a wider sense this branch of medicine comprises also the use of sea baths and of common water, but these subjects are treated in separate articles. *See* HYDROTHERAPEUTICS; and SEA AIR.

Courses of mineral waters and baths are to be regarded as methods of treatment analogous to courses of other remedies; but they are much more complicated, not only because many of the mineral waters are in themselves compound remedies containing several active substances in combination, but also because in most courses of waters or baths the invalid is influenced in body and mind by several other powerful agents, such as travelling; change of social conditions, occupation, scene, diet, and habits in general, mostly including increased exercise; and by change of climate. Each of these influences has in itself a powerful action, and to their combination we must often ascribe a great part of the curative effects of balneotherapeutic courses; they ought therefore to be carefully considered in every individual case as part of the plan prescribed. We are unable in this article fully to discuss these important concomitant influences, but may refer for their critical estimation to Dr. Braun's treatise *On the Curative Effects of Baths and Waters*, and other works.

As most chronic diseases are treated by other remedies as well as by balneotherapeutic courses, the physician must in every case consider whether and when mineral waters are to be used, either instead of other remedies, or in combination, or in alternation with them.

GENERAL COMPOSITION AND CLASSIFICATION. The principal constituents of mineral waters are: Water, sodium, magnesium, calcium, and iron; combined with hydrochloric, sulphuric, carbonic, and hydrosulphuric acids, the two latter existing also in some waters 'free,' that is, uncombined with bases. Nitrogen and oxygen are likewise present in most mineral waters in various proportions; and in some there are also silica, arsenic, bromine, iodine, lithium, manganese, potassium, alum, organic matters, and several other substances in small quantities.

The substances dissolved in mineral waters are derived from the surface-soil and the rocky strata through which the water deposited from the atmosphere passes. The dissolving power of this water is much increased by the gases which it absorbs, especially carbonic acid and oxygen. The constitution of mineral waters, therefore, varies

according to the nature of the strata through which they have passed.

The different mineral waters may be grouped in various ways, as, for instance, according to their chemical constituents, their temperature, their geological origin or geographical distribution, or their physiological or therapeutical actions.

The *chemical* classification, imperfect though it is, offers the advantage that it directs the attention at once to the most important constituents of the water. Some of the classes, however, are not named according to the substances contained in them in the *largest quantity*, but according to those considered most *potent*; such as the iron and sulphur waters. Another difficulty in the classification is, that some mineral waters contain several active substances in sufficiently large proportions to allow of their being placed in different classes; and, again, that some springs are so deficient in active principles as to render it doubtful where to place them. Of these latter, some appear to owe their virtues to the water alone, and its temperature, aided by the climate with which they are associated. Beginning with the latter as the most simple, we may group the mineral waters in the following principal classes :—

I. *Simple Thermal Waters*; II. *Common Salt* or *Muriated Saline Waters*; III. *Alkaline Waters*; IV. *Sulphated Saline Waters*; V. *Iron* or *Chalybeate Waters*; VI. *Sulphur Waters*; VII. *Earthy and Calcareous Waters.*

Some of the waters are chiefly used for bathing, others more for drinking, the majority for both purposes. In the consideration of the uses of the different spas, it is important to distinguish between the effects produced by the baths, and those caused by the internal use of the waters; and in larger works the plan followed by Dr. Braun, namely, to devote one section to 'bathing' and another to 'drinking courses of mineral waters,' offers advantages to the student; but in an article like the present it would be inconvenient, as frequent repetitions would be necessary.

The term 'baths' comprises not only the ordinary tub bath, but also swimming baths, or piscines; partial baths for the feet, the hands, and other parts; douches of great variety; vapour baths; carbonic acid baths; and mineral mud baths. At many places also inhalations of vapour and pulverised spray form part of the treatment.

We will now give a short account of the different classes.

I. Simple Thermal Waters.—The simple thermal waters are characterised by poverty in solid and gaseous substances, and hence low specific gravity; by perfect transparency; by great softness; and by elevated temperature—varying in the different spas from about 80° to over 150° F. Some of them contain nitrogen in larger proportions than the gases of waters usually do, others more oxygen. They are often called *indifferent* waters, on account of the absence of special mineralisation; and also *wild baths* (*Wildbäder*), on account of their being usually situated in wild mountainous regions.

Action.—The water of this class of spas when taken internally probably acts only as ordinary very pure warm water. By the drinking of warm as well as of cold water, the stomach is washed out; the secretion of bile, saliva, pancreatic juice, urine, etc., is increased; the tissue-change is augmented, and the removal of effete matters from the tissues and blood promoted; and by the acceleration of the retrogressive tissue-change, the progressive tissue-change becomes facilitated. As differences between warm water and cold water, we may mention that the latter acts more as a local excitant on the stomach, while the former is more easily absorbed, and makes less demands on the powers of the constitution, by not causing any expenditure of heat.

The simple thermal waters are much more used for *bathing* than for drinking courses; and the baths, as such, have probably the effects of ordinary warm baths, varying according to the temperature of the baths, and the time spent in them.

As the *fundamental effects of warm baths*, which effects form part of the action of all kinds of warm baths, simple as well as mineralised, we may regard—

(1) That they soften and cleanse the skin more rapidly than cold baths, and prepare it for perspiration.

(2) That they equalise and diminish the loss of heat, and, according to the temperature of the bath, lessen or prevent it altogether; and that, in the hot bath, heat is even added to the body.

(3) That the circulation in the skin is accelerated.

(4) That the organic functions and the tissue-change are slightly stimulated, or rather facilitated, without any strong reaction on the part of the organism.

(5) That the nervous system and muscular irritability are calmed.

(6) That the absorption of exudations is promoted.

These effects, as already mentioned, vary considerably with the degree of heat. In the *tepid bath* (from 80° to 95° F.) the central nervous system and the action of the heart are but slightly influenced; in the *warm bath* (from 96° to 102° or 103° F.) the heart's action is quickened, but the respiration is generally only slightly affected; in the *hot bath* (from 103° to 110° F.) the central nervous system becomes much more excited; not only is the heart's action further accelerated, but the respiration becomes rapid, and

sometimes irregular; and the hyperæmia of the skin leads to perspiration on removal from the bath.

Baths of a temperature above 110° F. are scarcely ever used, and only for a very few minutes. The effects vary also considerably, according to the duration of the immersion.

Uses.—The *drinking courses* of these waters may assist in the treatment of irritable forms of affections of the throat, stomach, and intestines, with spasmodic cough, cardialgia, constipation from sluggish secretion of bile and intestinal secretions; and by increasing the tissue-change, and removing used-up material, they are useful in chronic rheumatism and gout.

One of the main uses of the *simple thermal baths* is to allay over-excitability and hypersensibility of the nervous system in its various spheres; thus they often act beneficially in cases of neuralgia, hyperæsthesia, painful menstruation, and hysterical tendency. Their reputation in painful wounds and cicatrices is historical. In these cases, as well as in chronic rheumatism in its various forms and sciatica, the hotter are more useful than the tepid baths. In some forms of paralysis and loss of muscular power depending on peripheral changes, such as exudations on nerve-sheaths, good effects are produced; but if they are caused by changes in the centres of the nervous system, not much is to be expected. In gout the internal use of other mineral waters is generally required, but as second courses the simple thermal waters are often useful; and in many delicate gouty persons the balneotherapeutic treatment ought to be restricted to courses of tepid baths, aided by climate and diet. Most of these conditions can be also treated with other waters.

The ordinary thermal bath requires in many cases the assistance of douches and massage; and in some, douches are preferable to the ordinary hot baths, either alone or in combination with massage.

Enumeration and Selection.—The choice of a simple thermal spa is to be guided, not by the name of the disease alone, but also by the state of constitution, and many concomitant circumstances. The simple thermal waters deserve, *cæteris paribus*, the preference, when gentle management is required—when it is desirable to make as slight demands as possible on the powers of the constitution. Their action is in this respect greatly assisted by the mountainous climate enjoyed by the majority of these baths. The selection of a special spa in a given case depends on the nature of the case in the widest sense; on the degree of elevation which is desirable; on the means of treatment obtainable and customary at the different spas, including the most important agent—the spa physician; on the accommodation, the food, manner of living, and social conditions; on the distance and means of reaching the spa; and on many other circumstances. Information on these subjects can only be obtained by the study of larger works, and by personal visits. We can give here only the names of the principal spas of this class arranged according to their elevation:—

Name	Country	Elevation (approximative). Feet	Temperature of springs. Fahrenheit
Panticosa	Spain (Pyrenees)	5000	77°–92°
Leukerbad (Loeche-les-Bains)	Switzerland	4600	102°–122°
Bormio	Italy	4300	90°–104°
Gastein	Austrian Alps	3300	95°–114·8°
Pfäffers	Switzerland	2115	100·4°
Johannisbad	Bohemia	2000	86°
Bagnères de Bigorre	France (Pyrenees)	1850	90°–95°
Ragatz	Switzerland	1570	96°
Badenweiler	Baden	1425	86°–90·5°
Landeck	Silesia (Prussia)	1400	66°–84·2°
Wildbad	Würtemberg	1323	95°–98·6°
Plombières	France	1310	66°–156°
Luxeuil	France	1300	65°–163°
Neuhaus	Styria (Austria)	1200	95°
Liebenzell	Würtemberg	1113	72°–82°
Warmbrunn	Silesia (Prussia)	1100	96·8°–104°
Tobelbad	Tyrol	1090	77°–82°
Aix-les-Bains	Savoy, France	1060	86°–120°
Buxton	England	1000 (nearly)	82°
Schlangenbad	Nassau (Prussia)	900	81·5°–86°
Néris	France	800	114°–125°
Römerbad and Tüffer	Styria (Austria)	700–800	93°–100°
Teplitz	Bohemia	650	95°–120°
Lucca	Italy	500	100°–129°
Dax	France	130	127°–140°
Bath	England	100	100°–120°

Many other slightly mineralised warm waters, whose principal action is to be referred to water and heat, might be mentioned here, while several of the places contained in the list, as Leukerbad, Bormio, Bagnères de Bigorre, and Bath, might find places in other divisions.

The very hot Algerian baths, Hammam-Meskoutin, Biskra, and Hammam-R'Irha, the last beautifully situated some sixty miles from Algiers, belong likewise to this class.

The United States of America are likewise rich in simple hot springs, which are partly already in use, partly awaiting development. Sooner or later they will equal and perhaps surpass the most celebrated thermal waters of Europe. We will only mention here a few of them: the 'Hot Springs' in Virginia; the 'Hot Springs' in Arkansas; the 'Calistoga Hot Springs,' California; the 'Geysers,' California; the 'Paso Robles Hot Springs' in California; the 'Idaho Hot Springs' in Colorado; the 'Warm Springs' in North Carolina; the 'Warm Springs' in Georgia; 'Lebanon Springs' in Columbia county, New York; the 'Warm Springs' and the 'Healing Springs' in Bath county, Virginia. (For further information we refer to *The*

Mineral Springs of the United States of America, by G. E. Walton, M.D., New York, 1883.)

Allied in their action, though more powerful in their demands on the system and in their effects, are the natural hot-vapour baths in the large cave of Monsummano in Upper Italy, and in the smaller excavation in the rocks of Battaglia in the Euganean mountains.

II. Common Salt or Muriated Saline Waters.—Composition.—Common salt, or chloride of sodium, is the principal solid constituent of the waters of this class; but this substance is contained also in many other mineral waters, especially in some alkaline, some sulphur, and some Glauber's salt waters, and has a considerable share in the effects of these waters. Some of the springs in this class contain also appreciable quantities of iron, and of carbonates of sodium, lithium, magnesium, and lime, by which their action is modified.

Action.—In order to appreciate the action of the common salt waters, we must bear in mind that common salt forms part of all the tissues and juices of the body; that it promotes digestion; that it is essential to the formation as well as the disintegration of cells and tissues; that it stimulates not only the retrogressive, but also the progressive tissue-change or nutrition of the body; and that it is a great agent in the processes of secretion and absorption. Chloride of sodium stimulates the secreting apparatus of the stomach and intestines, and hence the action of the bowels and the circulation of the portal system, and indirectly the general circulation. It quickens the tissue-change; and through this, as well as the increased circulation, it promotes absorption of pathological products, without lowering the organism. In larger doses, however, beyond about five drachms per diem, irritation of the mucous membrane of the stomach and intestines may be produced. The action of the common salt waters is modified by their accompanying properties, especially by the carbonic acid contained in them, by their temperature, and by the degree of their concentration.

The *carbonic acid* in this and other classes of waters quiets the sensitive nerves of the stomach; stimulates the secretion and peristaltic action of the stomach and bowels; and indirectly increases the secretion of the kidneys. In large quantities, however, if not rapidly ejected by eructation, it may produce, by being absorbed, poisonous effects on the blood and nervous system. The presence of carbonic acid in salt waters increases the effects of chloride of sodium on the stomach and intestines, and by accelerating the passage of the waters from the stomach into the intestinal canal, promotes the action of the bowels.

Elevation of the temperature of the water produces more rapid absorption, and thus diminishes the local and increases the more distant and constitutional effects.

Concentration increases the local stimulation.

As to the action of these waters in the form of *baths*, the chloride of sodium and other chlorides (though any absorption through the skin of these and other salts contained in mineral waters is doubtful, or, at all events, forms only a small part of their therapeutic effects) stimulate the cutaneous ends of the nerves and the capillaries, and promote through this the nutrition and tone of the skin, and indirectly the tissue-change, an action which is heightened by the presence of carbonic acid, as witnessed at the gaseous saline baths of Rehme and Nauheim. The action of the salt and of the carbonic acid on the skin is, however, not to be regarded as merely local, but as transmissible from the nerve-ends to the various nerve-centres, and producing through these reflex effects.

Uses.—Salt waters and salt baths are useful in weakness of the skin; in tendency to rheumatic fever or bronchitis; in retarded convalescence from acute and chronic illness; in enlargements of joints from preceding inflammation; in scrofulous complaints; in many forms of anæmia and chlorosis—especially those where iron alone is not borne; in numerous cases of Indian cachexia; and in cases of sluggish circulation in the portal system, which leads to innumerable varieties of digestive troubles, to congestion of the liver, and of the pelvic organs in women, and to piles.

Enumeration and Selection.—The same classes of cases, as far as the name goes, are treated alike by alkaline and sulphated waters. The individual conditions must guide the practitioner in deciding for either the one or the other kind of waters, and for the special spa, according to the strength of the springs, the additional ingredients, such as lithium and arsenic at Baden-Baden, the amount of carbonic acid, and the climatic and concomitant conditions. Spare and pale persons, we may mention, mostly bear the common salt waters better than strongly alkaline and sulphated waters. Common salt waters are to be found in almost all countries; we can only give the most important or best known. In *England*: Droitwich—perhaps the strongest of all brines, with good arrangements, Nantwich, Ashby-de-la-Zouche (Ivanhoe Baths), Middlewich, Woodhall, and Harrogate; Leamington and Cheltenham contain likewise much common salt, in addition to sulphate of sodium. In *North America*: St. Catharine's Wells, Michigan Congress Spring, Spring Lake Well, Fruit Port Well, the celebrated Saratoga Springs, and the Ballston Spa. In *Germany*: Kissingen, Homburg, Rehme-Oeynhausen, Nauheim, Krouznach,

Soden, Pyrmont (which contains salt as well as iron springs), Wiesbaden, Hall in Austria, Hall in the Tyrol, Hall in Würtemberg, Reichenhall. Ischl, Kreuth, Dürkheim, Kosen, Kœnigsdorff-Iastrzemb, Krankenheil, Mondorf, Salzungen, Canstatt, Cronthal, Baden-Baden, and several others. In *France*: Bourbonne-les-Bains, Lamotte-les-Bains, Balaruc, Salins, and others. In *Italy*: Ischia, Castellamare, Castro-Caro, Monte Cattini, La Porretta. In *Switzerland*: Bex. In *Spain*: Las Caldas de Besaya, Las Caldas de Estrae, and Las Caldas de Mombuy.

III. **Alkaline Waters.**—Composition.—The alkaline waters contain *carbonate of sodium* as a prominent constituent; they are also more or less rich in *carbonic acid*; and some are distinguished by so large a proportion of *chloride of sodium* as to warrant a subdivision into—(1) *simple alkaline waters*; and (2) *muriated alkaline waters*.

Action.—In considering the dietetic and medicinal value of these waters, we must bear in mind that sodium in combination with carbonic acid is a most important constituent of the human body. Oxidation and tissue-change seem to be greatly influenced by the presence of soda; various proteid bodies seem to be kept in solution by it; it has a considerable share in the secretion of saliva and bile, and in the digestive processes; and, according to Liebig, it acts as a vehicle for the carbonic acid from the blood to the lungs.

Carbonate of sodium may be considered as an antacid, as a diuretic, as a promoter of tissue-change, and as a solvent. The beneficial effects of alkalis are in general produced only by a systematic use of *small* doses; whilst *large* quantities cause emaciation by their excessive solvent effect, and diminish the tissue-change by their depressing influence on the heart's action. The action of soda differs in this respect from that of chloride of sodium, which even in considerable doses increases the tissue-change, and does not so easily exercise an emaciating effect.

Uses.—The conditions in which alkaline waters are mostly employed are certain forms of dyspepsia, with undue acidity of the stomach; congestive conditions of the liver from sluggish portal circulation; tendency to gall-stones; diabetes; uric-acid diathesis, and its results—gravel and lithiasis; some forms of gout; and especially chronic catarrhal affections of the mucous membranes of the respiratory, digestive, and genital organs.

Enumeration and Selection.—Where it is necessary to improve the state of the blood, or to avoid emaciation, the muriated alkaline are preferable to the simple alkaline waters.

1. The principal spas with *simple alkaline waters* are—(*a*) *Hot*: Vichy, Neuenahr, Mont Dore, Chandes Aigues, and Neris, the three last being feebly mineralised; (*b*) *Cold*: Vals, Salzbrunn, Le Boulou, Evian, Bilin, Apollinaris, Gerolstein, Fachingen, Geilnau, Wilhelmsquelle, Taunus, Giesshübel, Soulzmatt, and Marcols. In North America—the Bladon Springs in Alabama, the Sheldon Springs in Vermont.

2. The chief *muriated alkaline waters* are —(*a*) Ems, Royat, and La Bourboule, which represent the *hot* springs; (*b*) Luhatschowitz, Selters, Gleichenberg, Roisdorf, Rosbach, Vic-sur-Cère, and Toennistein, which are *cold*. In North America the Congress Springs in California, and the St. Louis Spring in Michigan, belong to this class. The so-called California Seltzer Springs are peculiar in so far as they contain a larger quantity of carbonate of magnesium (10 grains in a pint) than of either carbonate or chloride of sodium. These springs seem therefore to offer advantages in oxaluria.

We ought to remark that several of the waters in this class, especially La Bourboule and Mont Dore, contain *arsenic* in appreciable quantities, while others contain lithium, as Royat.

IV. **Sulphated Waters.**—Composition. We include under this term those springs which are characterised by a preponderating amount of the sulphates of sodium or magnesium, or both sulphates together. They may be subdivided into (1) *simple sulphated waters* or *bitter waters*; and (2) *alkaline sulphated waters*, which latter contain also carbonate and chloride of sodium.

Action.—The *bitter salts* can scarcely be said to be constituents of the organism; they seem to act by stimulating, and in larger doses irritating, the mucous membrane of the stomach and alimentary canal, causing thin watery secretion, and in large doses diarrhœa. Sulphate of sodium is less irritating than sulphate of magnesium. The peristaltic action of the bowels is likewise increased by them. Their continued employment is apt to cause emaciation. By the presence of carbonate and chloride of sodium, the action of the bitter salts is modified.

Uses.—The bitter waters are useful in habits of constipation with sluggish portal circulation, in hæmorrhoidal tendencies, in congestion and enlargement of the liver and spleen, in some forms of dyspepsia, in gall-stones and allied affections, in gouty conditions, lithiasis, and diabetes; and, *cæteris paribus*, have in stout and in so-called plethoric persons the preference over the muriated saline waters.

Enumeration and Selection. — Where prolonged courses are required, the weaker sulphated waters, and especially the alkaline sulphated waters, are to be preferred; whilst the stronger bitter waters are more frequently selected for occasional purging doses. (1) The principal *simple sulphated* or *bitter waters* are: Pullna, Saidschutz, Sedlitz, Birmensdorf, Ivanda, Hunyadi János and

other springs near Ofen, Epsom, Rubinat, Las Caldas de Cuntio, Aranjuez, Friedrichshall, and Mergentheim, the two latter being also rich in chlorides. Weaker springs of a similar nature are at Leamington and Cheltenham—both with a large amount of common salt, at Scarborough, and at the Purton Spa. (2) The principal *alkaline sulphated waters* are Carlsbad, Marienbad, Tarasp-Schuls, Franzensbad, Elster, and Bertrich. The constitution and the action of the waters of Carlsbad and Bertrich are modified by their thermal nature. North America possesses some milder springs of this class: Estrill Springs, Crab Orchard Springs, Bedford Springs, Midland Well.

V. Iron or Chalybeate Waters.—Composition.—Iron is contained in the majority of mineral waters; but we regard as iron waters only those where the quantity of iron is, in proportion to the other constituents, so far predominant as to give a therapeutic character to the springs.

Action.—The formation of blood-globules, the contractility of the blood-vessels, the oxidation and the production of heat, and the general nutrition of tissues seem to be favoured by the use of iron waters. A small quantity only of iron seems to be absorbed by the stomach; none through the skin. The action of chalybeate baths seems to be due to the influence of the water and carbonic acid only.

Uses.—The conditions most benefited by chalybeate waters are the various forms of anæmia, or poverty of blood and particularly of red corpuscles, especially when caused by actual loss of blood, suppuration, or previous acute or chronic disease. The liver and digestive organs, however, must be in healthy working order, whilst in cases of anæmia accompanied by congestion of the liver and spleen, chalybeates alone are rarely useful, but must be preceded or modified in their action by the use of saline waters or other aperients; and this is often the case not only in anæmia of Indian and malarious cachexia, but also in chlorosis. Neuralgia, sterility, impotency, and general debility, are often benefited through improvement of the general health. Those iron waters are most useful which contain the iron in the form of the bicarbonate of the protoxide, kept in solution by free carbonic acid.

Enumeration and Selection. — Iron springs are (1) *comparatively pure*, that is, containing only a few grains of other substances in sixteen ounces of water: Schwalbach, Spa, Brückenau, Schandau, Liebwerda, Flinsberg, Freienwalde, Recoaro, Kœnigswarth, Liebenstein, Altwasser, Flitwick, Tunbridge Wells, and one of the springs at Harrogate; (2) *compound iron springs*, that is, which contain, in addition to iron and carbonic acid, a moderate quantity of other salts, especially the carbonates of sodium, calcium, and magnesium, the sulphates of sodium, magnesium, and calcium, and common salt: Aratapak, Orezza, Pyrmont, Driburg, Rippoldsau, Griesbach, Antogast, Petersthal, Elster, Bocklet, St. Moritz, Reinerz, Godesberg, Cudowa, Imnau, Bussang, and Santa Catarina. In North America: Bailey Springs, Stafford Springs, Greencastle Springs, Estill Springs, Schooley's Mountain Springs, Montvale Springs, Rawley Springs. Somewhat different in their action and less easily assimilated are the springs containing *sulphate of iron*. Representatives of this class are, in America—the Oak Orchard Acid Springs, the Bath Alum Springs, Stribling Springs, Bedford Alum Springs, and Variety Springs. The best known in Europe are: Flitwick in Bedfordshire, Muskau in Silesia, Parad in Hungaria, Alexisbad, and Ratzes. Rich in sulphate of iron in combination with *arsenic* are the waters of Roncegno and of Levico in the Austrian Tyrol; they are very powerful, and can only be taken in small doses.

VI. Sulphur Waters.—Composition.—Amongst sulphur waters we class those springs which contain either sulphuret of hydrogen, or the sulphuret of sodium, calcium, potassium, or magnesium, in an appreciable and constant proportion. They are partly thermal, partly cold; and some of them, especially Aix-la-Chapelle, Uriage, and Baden in Switzerland, the Columbia Springs in New York, and the Louisville Artesian Well in Kentucky, U.S.A., contain a considerable proportion of common salt and other solids, which are to be taken into consideration in the appreciation of their effects.

Action. — It is difficult to describe the physiological effects of the sulphur waters, so far as they depend on such minute quantities of sulphur as are contained in them. Sulphur-water baths seem to act in the same manner as simple baths. If the waters are taken internally, some sulphuretted hydrogen is probably absorbed, entering the circulation through the portal vein. The pure sulphur waters exercise a constipating rather than an aperient effect. The fæces become mostly blackened from sulphuret of iron. The protracted use of these waters is apt to lead to a certain degree of anæmia, possibly from the action of the sulphur on the iron of the blood-globules.

Uses.—Sulphur waters are mostly used in combined bathing and drinking courses, as also by inhalation, in cases of metallic poisoning; in congestion of the liver; piles; bronchial, laryngeal, and pharyngeal catarrh; in early chronic phthisis; in numerous cutaneous affections, especially the herpetic dyscrasia of the French; in rheumatism and gout; and in constitutional syphilis.

Enumeration and Selection.—The best known *thermal sulphur waters* are: Eaux Bonnes, Eaux Chaudes, Cauterets, Saint Sauveur, Barèges, Bagnères de Luchon, Ax,

Escaldes, Le Vernet, Amélie-les-Bains, Uriage, Allevard, Aix-les-Bains, Aix-la-Chapelle, Baden in Austria, Baden in Switzerland, Lavey, and Schinznach in Switzerland, Battaglia and Abano in the Euganean mountains; Panticosa in Spain; Mehadia, and other springs in Hungary; and Helouan or Helwan, near Cairo. *Cold sulphur springs* are: Eilsen, Nenndorf, Langenbrücken, Weilbach, Meinberg, Reutlingen, Enghien, Challes, Stachelberg, Heustrich, Gurnigel, some Harrogate springs, Llandrindod and Builth in Wales, Moffat and Strathpeffer in Scotland, and Lisdoonvarna in Ireland. There are also several important sulphur springs in the United States of America.

VII. Earthy and Calcareous Waters. COMPOSITION.—As *earthy* and *calcareous waters* we designate those springs in which the earthy substances, especially carbonate and sulphate of calcium and carbonate of magnesium, form the prominent constituents.

ACTION.—In the shape of baths, the earthy waters act almost in the same way as ordinary water baths. Internally taken, the carbonate of calcium exercises an antacid and a soothing effect on the mucous membrane of the stomach and intestines, and together with the sulphate of calcium is slightly astringent and constipating. If lime is absorbed, it may assist in the formation of cells and of bone, and may exercise also a soothing effect on other mucous membranes.

USES.—These waters, according to their composition, are useful in digestive troubles with tendency to acidity, diarrhœa, and undue irritability of the mucous membrane. They are employed also in osteomalacia, rachitis, and tuberculosis; and, further, in some skin-diseases, especially in eczema and psoriasis, where, however, the long continuation of the warm bath, that is, the soaking of the skin, is of more importance than the nature of the solid constituents contained in the water. Some of these waters possess a great reputation in chronic catarrh of the bladder, and in tendency to gravel and stone; but probably the large quantity of water consumed, as, for instance, at Contrexéville, and the consequent dilution of the urine and the washing out of renal tubules, are here to be regarded as the principal causes of the useful effect. The best known earthy or calcareous waters are: Wildungen, Lippspringe, with the Inselbad, Weissenburg, Contrexéville, Vittel, Bagnères de Bigorre, St. Arnaud, and Cransac; and amongst the table waters: Couzan, St. Galmier, and the Taunus water. In North America the best known earthy or calcic springs are: the Butterworth Springs, Eaton Rapid Wells, and Leslie Well in Michigan; the Gettysburg Spring in Pennsylvania; the Sweet Springs in West Virginia; and the Alleghany Springs in Virginia.

Many of the waters mentioned in other classes might also be mentioned here, such as Bormio, Leuk, Bath, and Lucca, named under the simple thermal waters; and Baden in Austria, Baden in Switzerland, Schinznach, Battaglia, Abano, and others enumerated under the sulphur waters.

On prescribing Mineral Waters and Baths.—In every case we must first settle the question whether the treatment by mineral waters and baths offers advantages over ordinary treatment. If the question is answered in the affirmative, we have to consider not only the nature of the disease, but quite as much the nature of the individual in whom it occurs; the amount of vital forces in general; the power of reaction; the state of the different organs; and whether they are healthy and vigorous and can assist in relieving the diseased part of the organism, or whether they are feeble or crippled and unable to respond to any unusual demand made on them. Thus we shall be enabled to decide whether stronger therapeutic influences can be employed; whether longer and rougher journeys are permitted, and colder climates and seasons; or whether delicate treatment is essential, comprising the simple thermal baths, summer temperature, mountain climates of moderate elevation, sunny aspects, and easy journeys. The baths and waters are not to be selected according to the chemical constitution of their springs alone, but the means and appliances in use, and the accustomed methods of treatment at certain places, the qualities of the local physician, the accommodation, the food, the cooking, and the social conditions, the facility of reaching a place, the climate and other elements of 'change,' are each and every one to be taken into consideration. It must be evident already from these remarks that the same morbid affection can occasionally be treated with advantage by different classes of mineral waters and at different spas, and that apparently widely different diseases may be benefited by the same spa; not only because many mineral waters are composed of different active elements, but also because the internal and external administration of the same water may be so much varied as to produce a great variety of effects. In many instances the disease itself cannot be directly attacked, but our efforts must be directed towards improving the general constitution, and through this influencing the diseased portion of the organism.

In most cases the local physician is as important as the nature of the waters, and in some even more so.

We cannot do more here than give some hints regarding the groups of diseased conditions in which mineral waters may be prescribed.

1. *Anæmia.*—In cases of anæmia it is

essential to consider whether the condition is caused, first, by direct loss of blood and its component parts; secondly, indirectly by acute or chronic disease, sleeplessness, neuralgia, and inability to take up food; thirdly, by congestion of the pelvic organs, with loss of blood and albuminous juices; or, lastly, by lymphatic diseases, or visceral affections resulting from warm climates or from habitual constipation. The more the first cause preponderates, the more we may expect from the direct use of iron; and we have then to consider whether pharmaceutical preparations, or iron waters with or without change of climate, with or without baths, are to be preferred. In the indirect forms of anæmia the mildest thermal treatment, with mountainous climates of moderate elevation, or the latter alone, with or without suitable medicinal treatment, are often the only beneficial courses in delicate constitutions; whilst in others somewhat less feeble according to individual conditions, common salt waters and baths with or without iron, or the gaseous tepid salt baths of Nauheim and Rehme, or the much stronger influences of sea air and of sea baths, are useful. In the third group the common salt waters, with a certain amount of iron, and occasionally the sulphated saline waters, must generally precede every other attempt at strengthening; for the acceleration of the portal circulation, the regular emptying of the different branches of the portal vein, and the increased tissue-change are essential to the improvement of the nutrition and sanguification; and only after such a preliminary course the purer iron waters and the higher alpine air are likely to become useful.

2. *Sluggish portal circulation.*—A sluggish condition of the portal system forms a frequent complication, not only of anæmia, but of a great many ailments of the different systems of the body; and is often only a part of a general want of tone in the organic muscular fibre, especially of the right ventricle and of the whole venous system. It is difficult to find a name for these, by no means rare, constitutional defects, which form the main characteristics of what the old German physicians called 'abdominal plethora.' If we only know what we mean by the terms, we may call these conditions *portal venosity* and *general venosity* according to the extent of the defect. They form the principal complications and in many cases the main cause of the most varied digestive troubles, as acidity, sickness, flatulency, constipation, and intestinal catarrh. They are also at the root of congestion of the hæmorrhoidal vessels and piles, of varicosity of the legs, of congestion of the womb and ovaries and menstrual anomalies, of congestion of the liver and imperfect secretion of bile, and of chronic bronchial catarrh, with dilatation and imperfect contraction of the right ventricle. Gravel and gout are likewise often associated with sluggish portal circulation. In the treatment of these very numerous complaints, widely different though they appear to be, we have therefore always to ask how far they are complicated by portal venosity, and in how far diet, regimen, pharmaceutical and balneotherapeutic treatment directed against this venosity may relieve the special case before us. If this portal venosity occur in *lean* and *delicate* persons, the common salt waters are often useful, as Kissingen, Homburg, Soden, the Saratoga Springs, Michigan Congress Spring, Spring Lake Well in North America, &c., which increase the tissue-change without impairing the nutrition, internally and in the form of baths, or the simple thermal baths in sub-alpine situations, assisted by the internal use of salt waters. If the individual be *stout* and inclined to costiveness, the sulphated saline waters with soda and common salt, such as Carlsbad, Marienbad, Franzensbad, Elster, Brides-les-Bains, Luhatschowitz, and Tarasp, are the most effective; while again in others of this class the simple alkaline waters, such as Vichy, the Congress Spring, &c., are preferable. In all these cases, however, the treatment by waters and baths ought to be assisted by regulation of diet and exercise.

3. *Gravel.*—Gravel, especially uric acid gravel, is usually complicated with portal venosity, and is to be treated accordingly. As a symptomatic treatment, the alkaline mineral waters have a more lasting effect than the administration of pharmaceutical preparations; but more effective are alkaline waters containing sulphates, and especially the less concentrated and hot springs of Carlsbad. Most useful of all, especially for home treatment, are the waters of Luhatschowitz, with their peculiar combination of carbonates and chlorides. The earthy waters of Contrexéville and Wildbad have a historic reputation, and owe this in part to the large doses which can mostly be prescribed.

4. *Gout.*—Gout is likewise often complicated with and aggravated by portal venosity, and we must always endeavour to facilitate the removal of the products of the retrogressive tissue-change; but gout occurs in the most widely different constitutions. If gout and its allied forms be met with in so-called strong constitutions, with a good primary digestion, ability to sustain a long morning fast, accompanied perhaps by a tendency to stoutness, and an acid urine of tolerably high specific gravity, becoming iridescent with nitric acid, the alkaline sulphated waters of Carlsbad, and sometimes those of Marienbad, Franzensbad, Elster, Tarasp, and Brides-les-Bains, are most useful, though they cannot altogether remove the gouty disposition. If the time be short, and a long rest after the course not permitted,

the simple alkaline waters of Vichy may be selected, and in more delicate constitutions the muriated alkaline waters of Royat, Ems, or Baden-Baden. In lean and weak gouty patients the common salt waters of Homburg, Kissingen, Harrogate, and Leamington, the arsenical salt waters of La Bourboule, the waters of Wiesbaden, the muriated sulphur waters of Aix-la-Chapelle, or, again, weak muriated alkaline waters like Baden-Baden, deserve a trial. In many delicate persons the simple thermal waters of Buxton, Schlangenbad, Wildbad, Ragatz, Gastein, and Bath, and the sulphur waters of Aix-les-Bains and Bagnères de Luchon, offer great advantages; but numerous cases may be regarded as quite intractable by baths, waters, and medicines, and in these diet and climate and regulation of exercise are the only means of management.

5. *Chronic rheumatism.* — In chronic rheumatism, associated with exudation round the joints, the hot thermal treatment is the most useful, either at the hotter simple thermal spas, as Bath, Teplitz, the Euganean baths, the hot springs of North America, or the natural vapour baths of the cave of Monsummano; at the weaker hot salt waters of Royat, Wiesbaden, and Baden-Baden; or at the thermal sulphur waters, such as Aix-la-Chapelle, Aix-les-Bains, Barèges, Bagnères de Luchon, and Eaux Chaudes. For more delicate cases, especially in those combined with weakness of the muscles of the heart, with or without valvular disease, we have the gaseous thermal salt waters of Rehme and Nauheim. In the muscular varieties, with stiffness, the hotter waters are specially indicated, assisted by douches and shampooing. In many instances, however, the cause of constantly recurring rheumatism is weakness of the skin, and here the tonic forms of the cold water-cure and sea baths promise more permanent good than hot baths.

It is impossible, in a limited treatise, to enter into all the morbid conditions suitable for balneotherapeutic treatment; but the preceding remarks may show that the physician, in prescribing waters, ought to base his advice on the teachings of physiology, pathology, climatology, and general therapeutics, in the widest sense.

We might be expected to give a few hints on diet during mineral-water courses, but no general rules can be laid down. Every individual requires rules for his own case; and rules which may be necessary during the use of muriated saline, or sulphated saline waters, are not necessary in other courses—for instance, of simple thermal or of iron waters.

The bath physician ought to guide every invalid, according to his or her individual condition, as well with regard to diet as to the internal or external use of waters, and with regard to exercise and other hygienic and therapeutic aids. The result of a course of waters often depends entirely on this guidance. It is important, therefore, to supply the bath physician with a statement as to the ailments and the constitution of the invalid.

Length of Treatment.—It is a general belief that three or four weeks is the term for a course of waters or baths; but it is impossible to fix a definite time. As courses of iodide of potassium, of iron, of quinine, or of mercury must be of different duration in different individuals, exactly so we find it with mineral waters; and as two or three courses of a remedy may have to be taken in the same year, so it is often desirable to give two or three courses of Vichy, of Carlsbad, or of Spa waters, in one year, though not all of them need be taken at the spring. In many cases preparatory courses are advisable—climatic, medicinal, and balneotherapeutic; and in as large a number secondary courses. Most invalids ought not to return immediately after a course of baths to their usual abodes and accustomed ways of living. In many instances, moreover, it is imperatively necessary to abstain from work, and to keep to a simple diet for about a month or more after the course of waters, and this is especially the case with the more powerful waters like Carlsbad and Marienbad.

Season.—As to the period of the year, there is no time when the different waters might not be drunk, if it were necessary. Most spas are open only from May till October, some longer; some only from June till September; but some few localities are partially open also during the winter, especially Aix-la-Chapelle, Aix-les-Bains, Dax, Amelie-les-Bains, Bath, Baden-Baden, and Wiesbaden. Many waters can be taken at home, and at any time of the year; but the elements of change are wanting, and the strict adherence to regimen and diet is often difficult. During the summer months the demands on the human body are diminished by the external warmth and the greater equability of the meteorological influences; nature is more exhilarating, and invites to outdoor life and exercise, without much risk of chills and their consequences. Delicate persons, therefore, ought to select the summer months for courses at the spas. The later parts of the spring and the autumn, however, offer advantages to the more robust, who at those times find the baths and the hotels less crowded, and who can then receive more attention from the bath physician. And, besides, those who are unable to bear heat have in the earlier and later parts of the season the benefit of cooler air, which is to the average visitor a real advantage at some of the hotter localities, like Aix-les-Bains, Aix-la-Chapelle, Ems, Creuznach, Soden, Baden-Baden, and Ragatz.

Hermann Weber.

MIRYACHIT (Russ. *miriatchitjc*, to play the fool).

Description.—This is the term applied in Russia and Eastern Siberia to a morbid condition, which, however, is met with under different names in various parts of the world. The term itself is part of a verb meaning 'to fool' or 'play the fool,' and the victim of the disease, if it may be so named, has a desire, apparently irresistible, to imitate whatever action is carried out in his presence, and also to repeat whatever is said to him or in his hearing. The condition, according to Dr. Jankovsky, is chronic, but subject to spontaneous remissions, and is not usually of such a character as to interfere with an ordinary occupation. The tendency is not infrequently hereditary, and is usually induced by contact with a *miriasha*—a person affected in this way; and, amidst a neurotic community in places where it is prevalent, the influence of such a person is in the highest degree disturbing. An exactly similar condition, according to Dr. Neale, is met with in Java under the name of *Lata*. On the northern frontier of Maine, between the United States and Canada, there exists the curious class of so-called 'jumpers,' who resemble in some points the sufferers from miryachit. But instead of imitating actions or repeating words, the sufferers from this condition are characterised by their inability to disobey any sudden sharp order which is given to them. Thus a man ordered to take hold of a red-hot stove was impelled to do so, although the effect was disastrous. A similar condition has been described by Dr. Bennett as existing in Griqualand among the natives and those of mixed race, who suffer from an irresistible impulse to dance, shout, or grimace on the occasion of any sudden or peculiar sound; and, like the 'jumpers,' they also will obey any sudden sharp order, oblivious of consequences.

Under whatever name or in whatever part of the world it is met with, the condition is essentially a psychical disturbance, and it affects chiefly those who are on the outskirts of civilisation. On the whole, men are more subject to it than women, and in the form met with in Africa men are apparently the only victims. In the Russian form, on the other hand, men are less frequently attacked than women. The condition has many resemblances to the great dancing epidemics of the middle ages, and almost seems like a relic of them. Like them, it spreads by contagion; and its manifestations are similarly the result of irresistible impulses, and are displayed amongst a class emotionally unstable and destitute of the self-control which is necessary in a well-ordered community. By some the Canadian form is ascribed to the excessive indulgence in tickling to which the class affected are addicted; but it is more likely that both this and its supposed effect are the expression of the same underlying instability.

Treatment.—Any treatment to be successful must be directed to combating the causes. Ordinary sedatives, such as the bromides, have been found to exercise little if any effect.

James Taylor.

MISCARRIAGE.—Synon.: Abortion; Fr. *Avortement*; *Fausse Couche*; Ger. *Fehlgeburt.*

Definition.—Miscarriage is the interruption of gestation before the fœtus has become viable.

Frequency.—The relative frequency of miscarriages, of premature labours (between the seventh and ninth months), and of full-time births, cannot be very closely estimated. Early abortions are often unnoticed or forgotten. The statement of Dr. Whitehead is very striking, that of sixty-four women who had lived in wedlock till the menopause, there were only eight who had not at some time had a miscarriage. His statistics show that the period at which abortions most frequently occur is about the third month.

Ætiology.—The causes of abortion may be found either: (1) on the part of the ovum or fœtus; or (2) on the part of the mother.

1. *Fœtal.*—The causes of miscarriage on the part of the ovum are: (*a*) all the diseases of the fœtus itself which compromise its life, such as acute fevers and chronic diseases—chiefly of syphilitic origin; and (*b*) many of the morbid changes in the fœtal appendages. Of the latter the most noteworthy are, first, diseases of the chorion, the most familiar of which is the hydatidiform degeneration; secondly, abnormal conditions of the umbilical cord, such as excessive torsion with constriction of the vessels, convolutions of it simultaneously round the neck and lower extremities, and the formation of tight knots upon it; and thirdly, abnormal relations and morbid conditions of the placenta. Where the placental area, for example, is of too limited extent, the ovum easily becomes detached from the uterus; where it is too large, extravasations of blood easily take place in the lobules. When the placenta is planted low down in the cavity of the uterus, it is liable to partial detachments; and thus in a great many cases abortion takes place at an early stage in patients who would have been subject to the greater dangers of unavoidable hæmorrhage had the pregnancy gone on towards the usual term. Again, the morbid processes which occur in the placenta, inflammatory, degenerative, or apoplectic, whether due to a syphilitic taint, or to other causes, lead to death of the embryo or fœtus, and thus in many instances to the early casting of the ovum. It is worth while to note that death of the embryo, and morbid changes in its appendages, do not necessarily

at once cause abortion. Three or four weeks usually elapse after the death of the fœtus ere its expulsion is effected; the decidual membrane having in the interval undergone retrogressive changes. It is only when such an extravasation of blood takes place as leads to sudden distension of the uterus, or when the membranes burst and such escape of liquor amnii occurs as leads to its sudden collapse, that the organ is stimulated to the immediate evacuation of its contents. Hence, while the ultimate cause of abortion is often enough traceable to the ovum, the immediate occasion is more frequently due to some maternal condition.

2. *Maternal.*—The causes of miscarriage on the part of the mother are either (*a*) *general*; or (*b*) *local.* (*a*) Amongst the *general* or constitutional conditions that favour the occurrence of abortion we note, first, all the causes that lead to depression of a woman's health. Abortions are frequent, for instance, in times of famine; amongst women who yield themselves to excesses; in anæmic women; and in those tainted with the syphilitic poison. Often enough, especially in the last class, the cause of the abortion can be traced to some morbid change in the maternal portion of the placenta; but sometimes it seems to be due simply to the impure or impoverished condition of the patient's blood. Secondly, fevers, such as the zymotic fevers, and acute inflammations, more particularly of important viscera, such as pneumonia, occurring in gravid women, very frequently become complicated by abortion. Thirdly, shock may bring on miscarriage, whether operating simply through the nervous system, of which we meet occasional examples, or, as is more frequently the case, by producing a more direct physical impression upon the uterus, as in cases where the patient leaps or steps suddenly down from a height, lifts a weight, stretches her arms above her head, or is exposed to any sudden jar or more protracted jolting. Though many cases of abortion are attributed to such a cause, it is always to be borne in mind that in some of these, at least, that supposed cause would not have led to the disaster unless there had already existed a predisposition in some morbid condition of the uterus or its contents.

Amongst (*b*) the *local* causes we find, first, and most frequently, diseased conditions of the deciduæ. Commonly in these cases the patient had previously been the subject of chronic endometritis; though occasionally cases are met with where there have been no marked symptoms previously, and the degenerative process may affect either the vera or reflexa or serotina, separately or simultaneously. Second in frequency under this head we have the abortions due to displacements of the uterus, these being commonly either descents or retroversions. Thirdly, neoplasms of the uterus, such as cancers or fibroid tumours, sometimes permit the occurrence of conception, but prevent gestation running to its natural term. Fourthly, the presence of tumours in the neighbouring organs, or inflammatory adhesions among them, may prevent the uterus from attaining its full growth, and compel it to early evacuation of its contents.

Symptoms and Diagnosis.—In dealing with a case of suspected miscarriage, we have to determine first that the patient is pregnant. This we do by a careful inquiry into the patient's history, and a complete physical diagnosis. Supposing that, by the usual investigation into the signs and symptoms of pregnancy, we are satisfied that gestation had begun, we have next to ascertain whether miscarriage is only threatening to come on, has fairly set in, or has already been completed.

The symptom that, in the great run of cases, first attracts attention, which usually goes on till the process is completed, and which continues for some hours or days subsequently, is hæmorrhage. The amount of blood lost varies indefinitely; and so does the manner of its escape. In certain cases the onset of pelvic pains, with the regular intermissions that betray their origin in the muscular contractions of the uterine walls, alarms the patient and attracts her attention before any escape of blood has taken place. These cases are exceptional. Usually the hæmorrhage precedes—and it may be for days or weeks—the expulsive action of the uterus. The cases, however, are rare—unless they be instances of very early abortion—where the process is completed without the accession of appreciably painful contractions. Occasionally there occur discharges of liquor amnii or other watery fluid, or of fragments of the degenerated membranes, or of the disintegrated fœtus.

These symptoms call for physical exploration of the uterus. If we find the uterus gravid, with the os undilated and the cervical canal above it unexpanded, the hæmorrhage being slight and the pains controllable, we regard and treat the case as one simply of threatened abortion. But if the pains are persistent, if the os uteri opens to admit the finger, or the canal of the cervix above it is becoming expanded; still more, if the uterine contents are being pressed down within reach of the exploring finger, we have to do with an actual abortion which it is useless to seek to avert. The treatment of actual abortion is often enough called for, even with quiescent uterus and closed canals, when the hæmorrhage is profuse.

In trying to determine whether the miscarriage is completed, we have first to examine the mole or mass that has been expelled. This consists sometimes of the ovum alone; of the ovum and decidua reflexa; or of the

ovum with all the uterine deciduæ. Where the uterine contents escape in broken-down fragments, and cannot be satisfactorily pieced together, it becomes necessary to examine the uterus, and even to explore the interior of that organ with the finger; and in these and other cases where the diagnosis is doubtful, it may be requisite sometimes to dilate the cervix with a carbolised sponge or tupelo tent, or with Hegar's dilators, in order to get full access to the uterine cavity.

Treatment.—The treatment of miscarriage varies according as we have to do with a case of (1) threatening abortion; or (2) abortion in actual progress; or (3) incomplete abortion.

1. *Treatment of threatening abortion.*—The treatment in a case where abortion is merely threatening is largely expectant. The patient is put to bed, and kept at rest in the recumbent position. All exercise or excitement, physical or psychical, must be forbidden. A light, non-stimulating diet, with fluids for the most part cold, is to be enjoined; and any tendency either to constipation or to diarrhœa is to be combated. Where the hæmorrhage is continuous and the uterus atonic or flaccid, small doses of ergot—twenty drops, every six or eight hours, of the liquid extract—are useful. Diluted sulphuric acid or gallic acid, either alone or in combination with digitalis, may be administered. Where there are occasional pains accompanying the discharge, the best effects are obtained from the administration of opiates, which may be prescribed in the form of the acetate of lead and opium pill. Where the pains constitute the more urgent symptom, and the hæmorrhage is less, it may be well to check the uterine action at once by the use of an anæsthetic followed by opiates, or the administration of a dose of chloral; and the astringent may then be dispensed with. The opiates in such cases are best administered hypodermically or *per rectum*. In many cases the liquid extract of viburnum prunifolium in doses of ʒss–ʒi has proved useful as a sedative to the uterus in threatened abortions.

2. *Treatment of actual abortion.*—Where the stage of expectancy is clearly over, and the patency of the os internum, the persistence of the pains, or the profusion of the hæmorrhage, calls for active interference, there are two main indications to be fulfilled—namely, to restrain the hæmorrhage; and to ensure the complete evacuation of the uterus.

To restrain the hæmorrhage, we compel the uterus to more energetic contraction, first, by the administration of large repeated doses of ergot. A drachm of the liquid extract may be given every three or four hours; but the effect of the drug can be most speedily and safely ensured by the hypodermic injection of ergotin—according to some such formula as this: ℞ Ergotini ʒij; chloral hydratis ʒss; aquæ destillatæ ʒvj—16 drops to be injected into the gluteal muscle. The dialysed solution of ergotin is said to produce less irritation. Secondly, the genital canal must be plugged. Where we have no other means at command of checking the discharge, a carefully applied vaginal tampon may be trusted; or the vaginal plug may be used where the hæmorrhage is going on but there is still some hope that the abortion may be arrested. Where the indication is more urgent, the introduction of a sponge tent into the cervical canal is very much more satisfactory, and in every way more efficacious. It arrests the hæmorrhage immediately and inevitably; it excites the uterus to more energetic action; and it at the same time expands the cervical canal in all its length. Where the indication is present for still more rapid dilatation of the cervix, this may be effected by means of bougies, such as Hegar's.

The complete evacuation of the uterus may takeplace by the unaided efforts of its muscular walls. On visiting a patient in the morning, who had a sponge tent passed into the cervix uteri and a hypodermic injection of ergotin over night, we may find sponge and ovum and all expelled. Where the ovum is still *in utero*, if it be loose and the cervix dilated, compression of the uterus from above the pubes may suffice to make it expel its contents. Usually, however, it becomes necessary to get at the interior of the uterine cavity with a finger or fingers passed through the vaginal canal. In most cases it greatly facilitates the operation to anæsthetise the patient, and in some cases the previous administration of chloroform is absolutely necessary. To render the uterus accessible to the exploring fingers, it must either be pushed down from above or dragged down from below. The patient lying unconscious on her back, the fundus uteri may be depressed by the left hand pushed firmly and steadily down through the pelvic brim. The depression may be effected by an assistant, but never so satisfactorily as by the operator himself. Not less than two fingers of the right hand should be used for the internal manipulation; the middle finger being folded in the fornix vaginæ, whilst the index passes through the os to the fundus uteri, and sweeps round the entire ovum, detaching it at any adherent points. Sometimes the middle finger more conveniently enters the uterine cavity; and in most cases of miscarriage in the fourth month, the whole hand, except the thumb, may require to be passed into the vagina, and two or more fingers into the uterine cavity. Even where the vaginal orifice is not at first very wide, if the hand be carefully warmed and soaped, and the interstices of the fingers filled up on their palmar aspect with a quantity of half-melted soap, sufficient dilatation is speedily effected. Occasionally the smaller left hand may be employed for internal manipulation, while

the stronger right is engaged in making the external pressure on the fundus uteri. Access to the interior of the uterus may in most cases be gained more easily by dragging the uterus down from below. One or other of the lips of the uterus—usually the anterior—is seized with a vulsellum, double or triple pronged, and slightly curved. One of the blades grasps the vaginal aspect of the front lip of the cervix as high up as the roof of the vagina, the other at a corresponding level within the cervical canal. The uterus is capable of being drawn far down without any injury to its ligaments, or any laceration by the bite of the vulsellum. It may be pulled down with the right hand and kept fixed by it, whilst the fingers of the left pass into the cavity, and explore and evacuate it. Or the vulsellum may be held in the left hand, or given to an assistant, to keep the uterus depressed, whilst the more familiar right-hand fingers do the intra-uterine work. The finger or fingers that have detached the ovum commonly succeed in extracting it, aided sometimes by pressure with the other hand from without. If not, there is no objection to laying hold of the loosened body with a pair of long dressing forceps, or a Lyon's or polypus forceps, and so withdrawing it; but no such instrument, even though it bear the name of abortion-forceps, ought to be trusted to for the detachment of a retained ovum or fragment of adherent placenta. The separation should always be effected by the direct action of the living finger.

3. *Treatment of incomplete abortion.*—In mismanaged cases the uterus is left imperfectly evacuated, and the patient continues to suffer from menorrhagia and metrorrhagia—it may be for months subsequently. In such circumstances the use of the curette is invaluable. Sometimes a degree of dilatation with tupelo tent or otherwise is required, but usually the cervical canal easily permits of the passage of a curette, with which the surfaces of the uterus can be scraped and the entire cavity of the organ can be cleared out. The curetting should be accompanied or immediately followed by the washing out of the cavity with a stream of hot water, of the temperature of 110° to 120° F., containing 1 in 5,000 of corrosive sublimate, or some such antiseptic, with the view at once of checking further hæmorrhage and disinfecting the uterine cavity.

After-treatment.—The uterus having been completely emptied, the patient should be kept at absolute rest in bed, and subjected to the same treatment as an ordinary puerperal female.

ALEXANDER RUSSELL SIMPSON.

MITOSES (μίτος, a thread).—The appearances which nuclei present at different stages of karyokinesis. *See* CELL.

MITRAL VALVE AND ORIFICE, Diseases of.—*See* HEART, VALVES AND ORIFICES OF, Diseases of.

MODIFIED.—A term applied to a disease, or to any of the phenomena of a disease, such as an eruption, when, as the result of a recognised cause, they present unusual characters, or run an unusual course. Thus, small-pox is modified by vaccination. *See* SMALL-POX.

MOFFAT, in Scotland.—Sulphur and also chalybeate waters. *See* MINERAL WATERS.

MOGIGRAPHIA (μόγις, with difficulty; and γράφω, I write).—A synonym for writer's cramp. *See* WRITER'S CRAMP.

MOLE.—MOLAR PREGNANCY. The moles that are met with in obstetrical practice are divided into two classes, (A) the *false*; and (B) the *true* moles. The false moles may be briefly dismissed, but it is desirable that they should be discussed in order to clear the ground for the consideration of the more important variety.

(A) **False Moles.**—False moles are so called as not being the result of conception. Substances unconnected with conception discharged from the virgin vagina are occasionally so described; such, for example, as shreds of vaginal mucous membrane, which the microscope should recognise. But the chief difficulty is with the membrane of membranous dysmenorrhœa, which may be mistaken for a true decidual membrane. Here we have to be guided by the history of previous attacks, the usual character of menstruation, and the microscopic examination of the discharged membrane, which shows the absence of structures characteristic of a fecundated ovum. Blood-clots, variously altered, may also be discharged by the non-pregnant, and give rise to some difficulty; especially partially decolorised clots, consisting mainly of fibrin. Here, again, the absence of chorionic loops is sufficiently characteristic. And, lastly, polypi and small fibroid tumours, or portions of larger ones, should not be difficult of recognition by naked-eye and microscopic examination.

(B) **True Moles.**—True moles are always the result of impregnation. Two varieties are recognised: (1) the *fleshy* or *carneous* mole; and (2) the *vesicular* or *hydatidiform* mole.

1. *The Carneous Mole.*—ÆTIOLOGY AND PATHOLOGY.—Extravasation of blood into the tissues of the developing placenta, or into the decidual membrane, or between the placenta and the uterine wall, rarely into the amnion, is the chief agent in the production of this mole. This extravasation may be due to any of the causes, such as over-exertion or excitement, which induce uterine action and lead to decidual detach-

ment. This damage to the ovular membranes leads almost invariably to the death of the embryo, which may entirely disappear or remain in the contracted amnial sac, small and blighted, surrounded by the thickened membranes, the whole forming a more or less firm and fleshy mass. On section, the inner aspect of the amnion presents an irregularly nodular appearance of a deep red, almost black, colour. If the amniotic fluid has escaped, and the embryo has entirely disappeared, the mass may still be recognised as originating in conception by the presence in its tissues of chorionic villi. A mole thus constituted may remain in the uterus for varying periods, but is generally expelled between the third and fifth months.

Symptoms.—The symptoms of early pregnancy become irregular, and ultimately subside; the size of the uterus, instead of increasing, becomes less; and, although at first there may be the customary cessation of menstruation, sooner or later irregular hæmorrhagic discharges, which may be bright, or chocolate-coloured from the breaking down of clot, and occasionally offensive from its decomposition, call attention to the interference that has occurred with the progress of the pregnancy. On examination, the uterus is found more solid than usual, and smaller than it should be were pregnancy normal.

Treatment.—The treatment essentially is to empty the uterus. While the mole remains in its cavity, the patient is exposed to the risk of hæmorrhage on the one hand, and of septic infection on the other. The administration of ergot may be sufficient to stimulate the uterus to throw off its contents; but should it not be, then the use of the sound will often succeed. Should the uterus still remain inert, we have to fall back upon the use of carbolised tents, or Hegar's dilators, to dilate the cervix, when the contents may be removed by the finger, by ovum forceps, or the curette, alone or in combination according to the special condition of each case. After emptying the uterus, it is advisable to wash it out with some warm antiseptic injection.

2. *The Vesicular* or *Hydatidiform Mole.*—The term 'hydatid mole' is somewhat misleading. There are no true hydatids in it. True hydatids are shut sacs, enclosed one within another, and containing echinococci; the vesicular mole consists of more or less pedunculated cysts, growing from one another.

Ætiology and Pathology.—All authorities agree that the vesicles in hydatid mole are formed from the chorionic villi. These undergo proliferation with myxomatous degeneration, and the cysts so formed contain fluid, in which mucin is found, as well as albumen and some salts. The vesicles vary in size from a small currant to a chestnut. Their mode of attachment one to another makes the so-called resemblance to a bunch of grapes incorrect. They are not attached by stalks to branches of a main stem, but each vesicle is attached by a pedicle to another cyst, and the first of the series, that nearest the ovum, springs direct from the outer surface of the chorion. The pedunculated structure intervening between the cysts represents the unaltered tissues of the villi. This degeneration affects the villi of the chorion within the first ten weeks of pregnancy. Later on, when the villi have become vascular and the placenta definitely formed, this degeneration seems incapable of occurrence. In most cases the embryo disappears altogether; in a few it may be found, but insignificant and blighted, the degeneration of the villi preceding and determining the death of the embryo. In these there is generally present some portion of placental structure, which is free from vesicular degeneration. These cystic villi occasionally penetrate the uterine wall, enter the sinuses, and even reach to the uterine peritoneum. The precise ætiology of this mole is still obscure; the balance of evidence is perhaps in favour of the error being maternal rather than fœtal, from its occasional recurrence in the same patient. And it is believed that, among maternal predisposing causes, syphilis holds an important place. It is more common in the multipara than in the primipara.

Symptoms.—The symptoms are at first those of ordinary pregnancy, but with the tendency to be more pronounced than under normal conditions. The abdominal swelling increases more rapidly than it should; the reflex symptoms are aggravated; and the patient complains of an unusual amount of discomfort and malaise. At the fourth month of pregnancy the uterus approaches the size usual at the sixth month. There is with this a tendency to the loss of the ovoid form, and the assumption of a globular or more transversely wide shape. In some cases there is a tendency to febrile disturbances.

Diagnosis.—Physical examination often yields important information. Palpation may give us, as Dr. Leishman remarks, a significant doughy sensation, with absence of any fœtal outlines in the uterus; while, at the same time, the intermittent contractions of the tumour prove it to be uterine. Auscultation reveals the absence of any fœtal heart sounds, and vaginal examination of ballottement. If any labour-pains have occurred, and the integrity of the ovum have been disturbed, the escape of some of the vesicles will make the diagnosis complete. The fluid being sanguineous in character, and the vesicles whitish, has given rise to the simile of 'white currants floating in red-currant juice,' attributed to Gooch.

Treatment.—The treatment consists in the removal of the uterine contents. This may be attempted at first by the adminis-

tration of ergot; failing this, the passage of the sound into the uterus will often stimulate uterine contraction, and induce the expulsion of the mole. Should still the uterus not respond, the use of tents rendered aseptic is indicated, or of Hegar's dilators, or, in the case of the more fully developed uteri, of the hydrostatic dilators. After dilatation of the os is accomplished, the contents of the uterus may be removed by two or three fingers introduced into its cavity, aided by external pressure on the fundus; in rare cases, it may even be necessary to introduce the whole hand.

After the removal of the uterine contents, it is advisable to wash out the cavity with some antiseptic solution, and, if there has been much hæmorrhage and a tendency to uterine inertia, with the solution of perchloride of iron used in *post-partum* hæmorrhage. It need hardly be said that the removal of the entire contents is of the first importance: should any portions be left, there is risk on the one hand of hæmorrhage, and on the other of septic infection.

It is important to remember that twin pregnancies may occur, in which vesicular degeneration affects the chorion of but one ovum; and that quite possibly the sound ovum may proceed to full development, as is said to have occurred at the birth of the anatomist Beclard.

Alfred Wiltshire. Henry Gervis.

MOLES.—Synon.: *Nævus Pigmentosus.*

Definition.—A mole usually consists of a small congenital fibrous growth of the skin, with an excess of pigment.

Description and Pathology.—Although moles are usually raised above the surface of the skin, and contain a certain quantity of fat and connective tissue, together with pigmentary deposits, yet we also occasionally meet with some which are flat, and appear to be nothing more than dark pigment spots; on the other hand, some fibrous moles are no darker than the surrounding skin. Not infrequently there is a small tuft of strong hair growing from the mole.

Properly speaking, moles are congenital, but dark spots exactly resembling them in superficial appearance are often met with as an acquired pigmentary change.

Moles vary much in size. As a rule they are not bigger than a split pea, but they are sometimes much larger. Usually they are single or very sparsely scattered over certain parts of the body; occasionally, however, they are met with in large numbers. The regions most commonly affected are the face, neck, back, and arms; much more rarely the chest, the abdomen, and lower extremities. They have no tendency to be distributed symmetrically.

Treatment.—Small congenital moles of the usual size can be easily destroyed by nitric acid or a saturated solution of potassa fusa in water. Large moles can only be removed by the knife, some positions being much more favourable to their removal than others. This point should be especially taken into consideration when the mole is situated on the cheek a little below the eye, as the contraction of the scar may interfere with the closure of the eyelid.

With regard to the removal of acquired pigmentary moles, the result of destruction by caustic is by no means always satisfactory. The writer has on several occasions seen the application of nitric acid followed by the production of a small central scar and a ring of pigment immediately outside, considerably larger than the original mole; this is never the case when the mole is congenital.

Robert Liveing.

MOLIMEN (*molior*, I move or stir).—An impulse or effort. The word is chiefly used in connexion with menstruation, to indicate the effort which appears to be made by the system to perform this function. *See* Menses or Menstruation, Disorders of.

MOLLITIES OSSIUM (Lat.).—Synon.: *Osteomalacia*; *Malacosteon*; Fr. *Ramollissement des Os*; Ger. *Knochenerweichung.*

Definition.—A condition in which the bones of the skeleton become by degrees decalcified, so that they can no longer sustain the weight of the body, but bend or break on slight provocation.

Mollities ossium has been called an excentric atrophy; but the minute changes which occur are not those of atrophy, but rather of active decalcification of the bone. It is a non-inflammatory lymphoid change, in which the bone is decalcified before the trabecular structure disappears.

Ætiology and Pathology.—The causes of mollities ossium are unknown. It affects the female sex almost exclusively; and only occurs in adults, and during the period of child-bearing. There is some intimate connexion between the outbreak of mollities ossium and the gravid state; and repeated pregnancies appear to predispose to its occurrence. The disease seems to occur in the lower classes of the people, who are exposed to hardship and have inadequate food. In certain localities it would seem to be endemic. Mollities ossium has been ascribed to changes in the nutrition of the bone; and to a process akin to chronic osteitis or osteomyelitis, but there is never any ossific periostitis. It has also been referred to an excess of lactic acid in the blood; and this acid is said to have been found in the bones and urine of persons affected by the disease.

Anatomical Characters.—The bone in mollities ossium becomes gradually decalcified, the change spreading from within outwards, until a mere shell of external compact tissue is left, but this cortical layer never

wholly disappears. The medullary cavity enlarges in all directions, occupying the epiphysis, and invading the cortical substance, until the interior becomes a gelatiniform mass, enclosed in a periosteal shell. The bone can be cut into layers with a knife, or indented by the pressure of the finger.

In the stage of acute progress the medulla is very vascular, the vessels are enlarged, and here and there extravasations of blood occur. The medullary spaces are filled with nucleated marrow-corpuscles; the trabeculæ give way; the osseous particles disappear; the fat-cells diminish, and gradually disappear; and finally the whole interior is filled with a pale or yellowish gelatinous substance. In extreme cases the external covering may be merely the fibrous periosteum, with a few plates of bone on its interior.

Symptoms.—One of the earliest symptoms of mollities ossium is aching rheumatoid pains in the affected bones, generally aggravated at night. The vertebral column, the ribs, and the pelvis are the parts first affected; and in these serious deformity shortly becomes manifest. The weight of the body causes extreme lateral and so-called angular curvatures. The ribs are bent and broken; one series of fractures taking place in the axillary line, usually directed inwards, is produced by external pressure; whilst a second or third row of fractures takes place by more indirect force—the one near the head of the ribs, the other outside the sternum. The arms often lie in a trough-shaped hollow on the sides of the body. The sternum gives way in several places, and is displaced forwards.

Through the weight of the body acting from above, the promontory of the sacrum is projected forwards, whilst the lateral pressure of the head of the femur against the acetabulum causes the transverse diameter of the pelvic outlet to diminish. It thus assumes a trifoliate shape, the pubic symphysis often projecting forwards at right angles to its normal direction, with its horizontal rami in contact; and the floor of one acetabulum may even touch the other. The bones of the extremities suffer from multiple fractures, and bend from the most trifling causes; and these are very imperfectly repaired in the later stages of the disease, although in the earlier they unite readily by bony callus. As the disease progresses, the body becomes more and more misshapen; the patient more completely helpless and bedridden; and death usually ensues from exhaustion, after a more or less protracted interval, or the sufferer is carried off by intercurrent disease. Female subjects frequently die in consequence of severe instrumental interference required during pregnancy. There is no constitutional cachexia.

Diagnosis.—The diagnosis of mollities ossium is at first very obscure. The pains resemble those of rheumatism. The character of the deformity will, however, settle any doubts. The disease should not be confounded with rickets, which is a disease of infancy or childhood, due to delayed ossification, and producing prominent curvatures of the shafts of the bones, and enlargements near the epiphyses, very distinct in type from the infractions and extravagant distortions of the osteomalacic skeleton. Nor does mollities resemble the fatty atrophy of bones due to senile changes, in which condition, though fracture be common, there is no general deformity involving different parts of the skeleton.

Prognosis.—The prognosis in most instances is unfavourable. In some well-marked cases of softening, the bones appear to have afterwards recovered their normal consistence, but this is very unusual.

Treatment.—No remedial measures, as yet discovered, have either arrested the progress of mollities ossium or promoted its cure. Women affected in this way should be restrained, if possible, from further childbearing, not only to avert increase of the disease, but to avoid the dangers attending childbirth in cases of deformed pelvis. Otherwise, an ample supply of nourishing food, rest in the recumbent position, and abundance of fresh air, are, combined with iron and quinine internally, the principal means of treatment at our disposal. William Mac Cormac.

MOLLUSCUM CONTAGIOSUM.—Synon.: *Meliceris*; Fr. *Molluscum Contagieux*; Ger. *Schwammgeschwulst.*

Description. — Molluscum contagiosum was first described by Bateman. It consists of small, round, prominent tumours, at first of minute size and translucent appearance, but slowly growing to the dimensions of a pea, or even, in rare instances, of a hazel-nut. The larger ones are sometimes pedunculated, but the smaller are for the most part sessile. In an early stage they have been aptly compared to a small drop of wax. In the centre of these little wart-like growths there forms a slight depression, so that they are more or less umbilicated, and this depression is believed by some to correspond to the open mouth of a sebaceous duct. Each tumour has a thick wall, and contains when developed a white, semi-fluid, milky substance, which may be easily squeezed out after making a small cut with the lancet. The little growths occur either singly or—more commonly—sparsely and irregularly scattered over the skin of the face and neck, and sometimes on other parts of the body. The older ones, after attaining a certain size, usually become inflamed and die out, while a new crop succeeds them. This affection is unattended with pain, itching, or any constitutional disturbance. It may be communicated from person to person by inoculation. The disease is not

a very common one, but is probably rather more often met with in England than in other countries; it is more common in children than in adults.

The most interesting point in connexion with molluscum contagiosum is the question as to its mode of production and propagation; and some difference of opinion exists even at the present time with regard to its contagious nature. On the whole, there is strong evidence in favour of its being propagated by inoculation. The evidence in favour of this is of two kinds—(1) that of direct experiment; (2) that of clinical observation. With regard to the former, the disease has been reproduced by artificial inoculation. The evidence derived from clinical observation is even more strongly in favour of the communicable nature of the disease. Many observers have recorded cases which it would be difficult to explain except on the supposition that the disease was contagious in a limited degree; but perhaps the strongest evidence ever adduced has been supplied in the experience of the writer. A single case of the disease was introduced into a girl's school in the parish of St. Marylebone, and in the course of a few months it had spread to eight other children in the school. Subsequently four more children and one of the servants were attacked, so that there were at one time in all fourteen cases. It is very difficult to understand how so large a number of children could be affected at one time unless the disease were in some way communicated from one to another, especially when we remember that it is far from common. Amongst adult sufferers from this disease a large proportion, in the experience of the writer, are frequenters of Turkish baths.

Diagnosis.—It is not easy to mistake molluscum contagiosum for any other disease, but we sometimes meet with small sebaceous tumours, especially about the scrotum in adults, closely resembling it in external appearance. They have, however, no contagious properties, and they do not spread over large areas of skin, a feature we are familiar with in molluscum contagiosum. It need hardly be pointed out that molluscum contagiosum must not be confounded with molluscum fibrosum, which is a perfectly different malady. *See* Molluscum Fibrosum.

Treatment.—When the number of growths of molluscum contagiosum is small, the treatment is simple. They should each be divided with the point of a lancet, and then be touched with some caustic. For this purpose the acid nitrate of mercury may be used, or a saturated solution of potassa fusa in water. When the little tumours are very numerous, it is probably best to leave them entirely alone; after a time they become a little inflamed, dry up, and disappear. The disease, however, if left to itself, is always tedious.

Robert Liveing.

MOLLUSCUM FIBROSUM.—Synon.: *Molluscum Simplex*; *Molluscum Pendulum*; Fibroma; Fr. *Molluscum Fibreux.*

Description.—This disease consists of small tumours of hypertrophic fibrous tissue springing from the subcutaneous structures. Some of these may remain undeveloped, and, though not visible to the eye, can be felt by passing the hand over the skin. Others form visible, though small, sessile growths; more frequently, however, the little tumours are pedunculated and pendulous, somewhat egg-shaped, and covered with normal skin. The size of these growths varies from a small pea to a filbert, or larger; sometimes they even attain the dimensions of a hen's egg, but this is very exceptional. The skin covering them is of a natural colour, and rather more vascular than normal; the consistency of the tumour is soft, but at the same time firm on pressure. The affection is quite unattended with pain or with subjective sensations of any kind. The disease may take the form of single or a few scattered pedunculated tumours, or the whole body may be covered with them. It is highly probable that these outgrowths exist in an undeveloped form at the time of birth, though they may be too small to be detected; at all events they show themselves at an early age. When fully developed they have no tendency to undergo further changes, such as those of ulceration or degeneration, but remain stationary during life. They belong to the category of hypertrophic malformations of the skin, rather than to that of morbid growths. Hebra has rightly pointed out that those who suffer from general molluscum fibrosum are often somewhat mentally deficient—that is, they may be imperfectly developed in mind as well as in body.

Treatment.—This consists in snipping off the little pedunculated tumours with a pair of scissors. It is unnecessary to interfere with those which are not pedunculated.

Robert Liveing.

MONOMANIA.—Synon.: Fr. *Monomanie*; Ger. *Wahnsinn.*—This term is falling into disuse by reason of its vagueness, and because it has been employed by various writers to denote different kinds of insanity. Some have used it to denote an insanity which is indicated by some one particular delusion, the mind remaining clear on every other point. Others mean by it an insanity without delusion, an *affective* or *impulsive* insanity, the essence of which is the absence of delusion, and the so-called integrity of the intellectual portion of the mind. Esquirol thought it a disorder of the faculties limited to a few subjects, with excitement, and gay and expansive passion; while, according to others, melancholia without delusion would be an instance of affective monomania. We may take it, however, that all authors are

agreed in using the term 'monomania' to indicate a partial insanity, which enables the patient to converse and act rationally to a considerable degree, and therefore renders his responsibility a matter of question. Such cases form the grounds of forensic contention, whether criminal or civil; but it is better to affix to them some more precise term, and to indicate symptomatologically and pathologically the exact nature of the mental and bodily condition of the alleged lunatic.

G. F. BLANDFORD.

MONSUMMANA, Cave of, in Upper Italy.—Natural vapour baths. *See* MINERAL WATERS.

MONT DORE, in France.—Simple thermal water, containing arsenic and soda. *See* MINERAL WATERS.

MONTE-CATINI, in Tuscany.—Thermal muriated saline waters.

MONTMIRAIL, in France (Vaucluse).—Sulphated saline, bitter waters.

MONTPELLIER, in the South of France.—Variable, fairly warm, winter climate. High winds from N.E. and N.W. *See* CLIMATE, Treatment of Disease by.

MORAL INSANITY.—*See* INSANITY, Varieties of.

MORBID (*morbus*, a disease).—This word merely signifies *diseased*, and is used, in its several applications, as a technical or scientific term, in contradistinction to the term *healthy*. Among the most common examples of these applications may be mentioned *morbid anatomy* and *histology*, which imply the anatomy and histology of diseased conditions; *morbid sensations* or *feelings*, as distinguished from healthy sensations, whether connected with either of the ordinary senses or with some particular organ, such as appetite; *morbid actions*; *morbid secretions* or *discharges*; and *morbid growths*. The word is employed in a somewhat special sense, in relation to individuals who are mentally low in spirits and despondent, without any obvious cause to account for this condition; such individuals are often spoken of as being in a *morbid state*.

MORBIDITY (*morbus*, a disease).—This term is employed to denote the amount of illness existing in a given community; and, as 'mortality' expresses the death-rate, so 'morbidity' indicates the sick-rate, whether the diseases be fatal or not.

Since health is an extremely ill-defined state, marked out by no absolute boundaries, and since many people suffer from diseases that are concealed intentionally or through ignorance, it becomes a matter of considerable difficulty to express with certainty the amount of illness that may exist at any time. Some information may, however, be obtained from the records of sick-clubs and benefit-societies, on which statistics may be based of the average time their subscribers are ill during the year, in relation to employment, age, locality, and other circumstances. From the statistics of these friendly-societies it has been estimated that nine days in the year per member are lost through sickness.

By an investigation of this subject the rates of mortality come to possess an extended significance, for they thus indicate not merely the proportion between the living and the dead, but between the latter and the two classes of the living, namely, the healthy and the diseased; and, as a branch of State Medicine, they must doubtless come to take a prominent place. As further knowledge provides accurate facts and figures, the subject will have a distinct practical bearing, in estimating the value of men for work, if the average liability to disease and the total amount of illness an individual may expect to suffer be known; while it is reasonable to believe that as the 'aptitudes to disease' are further conditioned, the means for prevention may be extended.

W. H. ALLCHIN.

MORBIFIC (*morbus*, disease; and *facio*, I make).—This word is properly applied to any cause that produces a disease. Such a cause is often spoken of as a *morbific agent*.

MORBILLI (dim. of *morbus*, a disease). A synonym for measles. *See* MEASLES.

MORBUS.—This is the Latin word for *disease*. Formerly it was frequently employed, but is not much in vogue at the present day. When applied to particular diseases, it is associated with some qualifying adjective or noun, indicating the nature or seat of such disease, some peculiarity by which it is characterised, or the name of some renowned authority upon it. It would not serve any useful purpose to give a list of the diseases with which the word is connected, and it will suffice to cite, as examples, some of its more common applications, such as *morbus cordis*, disease of the heart; *morbus coxæ* or *coxarius*, disease of the hip-joint; *morbus cerealis*, ergotism; *morbus Brightii*, Bright's disease; *morbus cæruleus*, blue disease, cyanosis.

MORGINS, in Switzerland.—Chalybeate waters. *See* MINERAL WATERS.

MOROCCO, in North Africa.—A warm, healthy winter climate. Tangiers is exposed to cold, damp S.W. winds in autumn and spring, and to E. winds. Living is superior to Malaga. *See* CLIMATE, Treatment of Disease by.

MORPHINISM.—Synon.: The Morphine Habit; Fr. *Morphinisme*; Gr. *Morphiumsucht.*

Definition.—A term applied to the habitual indulgence in morphine, or—in a more extended sense—in any preparation containing that alkaloid.

Forms and Quantities.—Opium-eating, laudanum-drinking, opium-smoking, and the hypodermic injection of morphine as a practice are all forms of morphinism. It is undoubted that most adults can by use habituate themselves to the taking of large doses of opium, but to this there appears to be a personal limit, and some are so susceptible to the influence of the drug that no tolerance of it is ever established. Half a pint of laudanum per diem, or three-quarters of an ounce of opium, are doses that have often been reached, and the former appears to have been De Quincey's maximum. Half or a third of this, or even less, is a more usual quantity. The largest amount the writer has known to be taken for a lengthened period was an average of forty-eight grains of acetate of morphine per diem, used in injections, with a maximum of ninety-six grains per diem on some days. Its use is often combined with that of cocaine, which prevents the after-sickness attendant upon the use of morphine.

Ætiology.—Morphinism is most frequently met with in neurotic individuals. The habit originates usually in the legitimate employment of morphine or opium for therapeutic purposes. In other instances it can be traced to a single definite act of indulgence in the drug—either casually, or in obedience to the promptings of some hereditary craving or of depressed melancholic feelings.

Effects.—So far as the effects on the organism are concerned, it is immaterial whether opium or the alkaloid be swallowed or used hypodermically. Minor differences there are, but the general results are the same. These are listlessness, loss of energy, inaptitude for business and exertion, dreaminess, exaltation of fancy, loss of appetite, emaciation, a sallow skin, diminished liver and kidney secretion and hence costiveness. Digestive troubles are prominent, attributable to the use of the drug; and yet if this be suspended the craving for it becomes intolerable, so that no amount of resolution as a rule leads to total abstention from its use. But many or all of these symptoms, except the craving, may be absent; and most physicians have had experience of opium-takers whose habit in this respect would not be suspected from their appearance. Probably, on the whole, the indulgence in opium tends to shorten life, though this has been doubted, and opium-takers are asserted to be unusually free from catarrhal affections. Nevertheless, morphinism is a most baneful habit; and though it may not appreciably shorten life, or cause serious maladies, the morphinist is often indolent, weak, untruthful, and irresolute, unfitted to lead a life of active and useful exertion.

Great differences of opinion exist as to the pernicious or other effects of *opium-smoking*. Some would have us believe that the practice is pernicious, not to say deadly; but debasing it often is. The pictures drawn as to its effects are evidently coloured by the bias of the observer. On the other hand, some would persuade us that the practice is harmless, not to say beneficial. Doubtless neither view is absolutely correct, and whilst opium-smoking is pernicious, the evils have been greatly exaggerated. Moreover, opium-smoking is so bound up with other vicious and idle habits, as to make it very difficult to differentiate between the effects of opium and of such habits. Excess in opium-smoking, like excess in tobacco-smoking, is injurious, and too often indulged in by the idle and dreamy. But it is doubtful whether very distinct and unmistakable results can be traced to a slight indulgence in opium-smoking. Morphine is not volatilised during the process, and the basic bodies volatilised are analogous to those volatilised in tobacco-smoking, such as picoline and pyridine, which, however, undoubtedly have marked physiological activities.

Treatment.—The one point in the treatment of morphinism—be it laudanum-drinking, the hypodermic use of morphine, or opium-smoking—is to cut off the use of the drug at once and completely, and every effort should be made to accomplish it.[1] Seclusion and the influence of a special nurse conduce powerfully to a successful result; and massage is sometimes a useful adjunct. The craving for opium is, however, so overpowering, and other symptoms become so urgent, such as intense headaches, insomnia, vomiting, diarrhœa, palpitation, dyspnœa, and heat and dryness of the skin, that the patient has seldom resolution enough to avoid its use. Seclusion, with constant vigilant attendance, is generally indispensable. Tonics, cold baths, moderate exercise, and good food constitute the best treatment. A week or two's abstinence may suffice to break off the habit, but very commonly the patient relapses into his old vicious practice. A yachting excursion or a long sea voyage, without access to opium, may effect a cure when all other means have failed.

Thomas Stevenson.

MORPHŒA.—*See* Scleroderma.

MORTALITY.—Synon.: Rate of Mortality; Death-rate; Fr. *Mortalité*; Ger. *Sterblichkeit.*

Definition.—The proportion of persons dying to those surviving under given circum-

[1] According to some authorities, it is better to reduce the morphine gradually before its complete removal.—Editor.

stances; or, more usually, the proportion borne by the persons who die to the whole number of those subjected to the given circumstances.

Thus we may have to do with the annual mortality of the population of a country, a district, or a city; or of a body of men similarly circumstanced, as of clergymen or of lead-miners; or of bodies of men otherwise alike, but subjected to different conditions of climate, &c., as the British army; or of the population, or any section of the population, at special ages, as of infants in factory towns.

Or we may be concerned with the proportions of deaths to survivors, or to the whole number of entrants, during and after exposure to a special cause or causes of death, operating either speedily or during a protracted period. Hereunder come, for example, the mortality sustained by the population of Rio Janeiro, or New Orleans, during an epidemic of yellow fever; or that suffered by a number of persons in passing through an attack of enteric fever or pneumonia.

Estimation of Mortality.—The annual mortality of a population is reckoned, not on the numbers in existence at the beginning of a year, but on the average number in existence on the several days of the year, or, what is nearly the same thing, on the mean population of the year. The necessity of this becomes evident, when we consider that in our own country the large towns are mostly increasing at a very rapid rate, while some agricultural parishes and unprosperous places actually decline in population. In the towns, therefore, the death-rate, if reckoned on the last census, or even on the number believed or estimated to exist at the beginning of the given year, would come out higher than it ought to be, while in declining parishes it would be somewhat too low. Similarly the annual mortality of bodies of troops is calculated on the mean strength.

Two formulæ are in use for specifying death-rates. In the first the proportion of deaths is taken as unity: thus, the mortality in England and Wales in 1878 would be stated as 1 in 46. In the second, which is more convenient and is now generally employed, the number of lives at risk is taken as 100 or 1,000: thus the mortality of 1878 would come out 21·7. Either formula is convertible into the other by simple division: thus $1,000 \div 46 = 21{\cdot}7$; and $1,000 \div 21{\cdot}7 = 46$.

The death-rates of large civilised countries, in which registration is strictly carried out, give a pretty fair representation of the viability of the population. So much may be said for England, Wales, and Scotland, and for most of the European States, but not, unfortunately, for Ireland, where the weakness of the registration laws makes the record defective.

Mortality of Nations.—The following were the death-rates per 1,000 of most of the principal States of Europe during the periods indicated:—

	In years	Per 1,000 living
Norway	1846–55	17·9
Sweden	1869–78	18·9
Denmark	"	19·2
England and Wales	"	21·8
Scotland	"	22·1
Belgium	"	22·6
Switzerland	1870–78	23·5
France	1869–78	24·3
Or excluding two years of war	. . . .	22·5
Netherlands	1869–78	24·4
German Empire	1872–78	27·2
Italy	1869–78	29·5
Spain	1861–70	29·7
Austria	1869–78	31·1
Hungary	1868–77	39·6
Or excluding two cholera years	. . . .	36·1

The ensuing table exhibits the death-rates of the same countries a few years later.[1] In every case there had been more or less improvement:—

Norway	1882–86	16·9
Sweden	1882–85	17·5
Ireland	1882–86	18·1
Denmark	"	18·5
Scotland	"	19·3
England and Wales	"	19·4
Belgium	"	20·6
Switzerland	"	20·7
The Netherlands	"	21·5
France	"	22·2
Prussia	"	25·5
Spain	1876–78	25·8
German Empire	1882–86	25·9
Italy	"	27·3
Austria	"	30·0
Hungary	"	33·4

The death-rate of Russia, except in the extreme north, is high. It was stated at 35·9 in 1842. That of Portugal the writer has not been able to obtain. Those of Turkey and of Greece are unknown. In many of the British colonies it is lower than even in Norway. Thus the average mortality during the five years 1882–86 was in [2]

Victoria, 14·8	New South Wales, 15·6
Queensland, 19·7	South Australia, 14·3
West Australia, 18·6	Tasmania, 15·6
New Zealand, 10·8	

Mortality of Cities.—The mortality of cities is in this country almost invariably higher than that of the open country. But this rule does not apply to all other countries; the exceptions occur mostly where endemic fevers are prevalent in the country. Thus the mortality rate in 1887 was in London, 19·6; in Edinburgh, 19·8, and in Dublin, 30·6; and in 28 other large towns in England it varied between 16·9 in Brighton and 28·7 in Manchester; while in 50 towns of the second class the extremes were 12·4 at Maidstone and 13·3 at Burton; 23·8 at Stockport and 24·9 at Wigan; the average of the 28 towns being 20·8 per 1,000, and of the 50 towns 19·0. In the same year the rural dis-

[1] These figures have been brought up to date as far as possible.—Editor.

[2] Hayter, *Australian Statistics.*

tricts and small towns of England yielded an average rate of 17·4 only. There are a considerable number of districts, almost all rural, which year after year fall below 17; and 17 was accordingly fixed upon by the late Registrar-General for England as a kind of standard to be aimed at by sanitarians. And there are districts in England, and entire small counties in Scotland, where the rate frequently falls below even 15.

The following table exhibits the death-rates experienced in 1878, and again in 1887, in a number of foreign and colonial cities:—

	1878	1887		1878	1887
Calcutta	37·7	24·0	Paris	24·0	23·0
Madras	48·8	40·0	Brussels	28·0	21·0
Bombay	41·8	26·0	Amsterdam	24·4	22·0
New York	24·8	26·0	Rotterdam	27·3	21·0
Brooklyn	20·1	23·0	The Hague	26·4	20·0
Philadelphia	18·0	22·0	Copenhagen	22·0	24·0
Montreal	30·9	—	Stockholm	22·4	21·0
Alexandria	45·4	38·0	Christiania	18·5	23·0
Melbourne, 1873			St. Petersburg	47·1	28·0
and 1875	22·8	21·0	Berlin	29·9	22·0
Rome	29·8	29·0	Hamburg	26·9	27·0
Naples	33·1	—	Dresden	24·7	22·0
Turin	31·1	26·0	Munich	34·6	30·0
Venice	28·7	25·0	Breslau	29·9	29·0
Trieste	36·2	29·0	Vienna	29·6	26·0
Geneva	23·6	21·0	Budapest	40·3	32·0

Analysis of Results.—These tables awaken, by the enormous differences between the several cities and countries, a curiosity respecting the causes of such differences, which, however, the figures themselves go far towards satisfying. It is at once evident that, whatever may be the case in the open country, cities suffer to a considerable extent in the ratio of their ignorance and neglect of sanitary laws, and of the poverty and squalor, or barbarism of their populations. Mark, for example, the contrast between Philadelphia or Geneva, and Alexandria, Budapest, or St. Petersburg! Cities having a steadily warm climate, or a climate of extremes, are more unhealthy than those which enjoy a temperate one. By this consideration, combined with that of their superior civilisation, may be explained the favourable position of the cities of Western as compared with those of Eastern Europe. The short, hot summers are very fatal in the latter region, and even in Southern Germany and at Stockholm; while in Western Europe generally, and especially in Scotland, winter and spring are the deadly seasons. It is noteworthy that in most of the large cities of Italy the short, sharp, and changeable winter is not less deadly than the hot summer and malarious autumn; in fact good winter climates for *poitrinaires* are exceptional even in Italy.

In Great Britain the influence of climate *per se* on the annual mortality of the several cities and districts is not very great; and its effects are obscured by those of other agencies. But if we confine our attention to the rural districts, where the disturbing factors are less important, we shall find that the rates of mortality are on the whole slightly more favourable in the north than in the south. Of all the counties in Great Britain Orkney-and-Shetland stands best, with an annual mortality, on an average of 10 years,[1] of 15·13; and Shetland, the more northern division, stands better than Orkney. Great Britain is, therefore, no exception to the rule that in Europe mortality decreases from south to north. This is in no way inconsistent with the fact that throughout Great Britain winter is the deadly season, and cold is more fatal than heat, thoracic than abdominal diseases.

Influence of Seasons.—The following were the death-rates of the four seasons in England and Wales, in 1868–77:—

	Winter	Spring	Summer	Autumn	Year
In the chief towns	25·8	22·5	23·1	24·2	23·7
In the small towns and rural districts	21·7	19·3	17·2	18·5	19·0

In Scotland the seasonal mortality, owing, doubtless, to the less intensity of the summer heat, follows pretty nearly the order of the English small towns and rural districts. Thus, in 1878: winter, 25·2; spring, 23·2; summer, 19·8; autumn, 20·4; year, 22·3.

It would seem, however, that in London, in the early part of the seventeenth century, when the death-rate, owing to the closeness and filthiness of the city, was fearfully high, the maximum was attained in summer, the figures standing as follows in 1606–10, during which years the plague was absent. Average mortality per cent.: winter (J. F. M.), 1·4; spring, 1·5; summer, 2·7; autumn, 2·0; total, 7·0.

Influence of Density of Population.—In accordance with a principle already laid down, that in communities sufficiently advanced to furnish mortality statistics the death-rate diminishes with the progress of civilisation, the mortality of London has since the seventeenth century gradually and greatly diminished. At the beginning of this nineteenth century it had sunk to 29, in 1840–49 it was 25·3, in 1870–78, 23, and in 1887 only 19·6.

The death-rate is also diminishing in France, Belgium, the Netherlands, Sweden, and Germany, in all of which countries the population is believed to be advancing in comfort and general well-being; but in southern and eastern Europe, where comparatively little advance has taken place in these respects, no such diminution can be demonstrated.

Nor, though evident in London and in several other great towns, can a large and permanent diminution of the death-rate be

[1] 1866–75.

positively affirmed of Great Britain generally. In Scotland, indeed, there was a decided increase from 1855 until 1876, when a decline, which may prove transient only, set in. And in England no improvement could be shown for many years before 1871, since which date there has been an almost unbroken succession of years of low mortality concurring with a generally low temperature and excessive fall of rain.

The great antagonistic influence in Great Britain may be found in Dr. Farr's principle, 'That mortality increases with density of population.' And 'urbanisation' advances so rapidly in Great Britain, that all the efforts and devices of sanitary and medical science are scarcely able to do more than neutralise its evil effects. Part of the apparent improvement is largely due to the diminution of typhoid fever. Contrary to the general belief, the expectation of life in males aged over 20, and in females over 45, was actually less in the period 1870–80 than in that of 1838–54.

Sources of Fallacy.—It may be as well to advert to some of the principal sources of fallacy, which hamper us in appreciating national and local death-rates. One of these is the varying number of births. The birth-rate ranges in the Continental States of Europe from about 40 in Germany and Austria, and even more in Russia and Hungary, down to 25 in France;[1] and in Britain from 48 or 50 in some coal and iron districts, down to 22 in the county of Sutherland. The late Dr. Letheby maintained that a high birth-rate was a direct cause of a high death-rate, owing to the great mortality among infants. This was an error; the two often concur, but the former is not a cause of the latter, unless where the infants perish in enormous proportion. The usual result in this country of a large and especially of an increasing birth-rate, is to augment in the community the proportion of children beyond infancy, and of young persons, who ordinarily suffer a very low death-rate as compared with old or even middle-aged persons. The favourable rates prevailing among these young porsons overpowering the unfavourable ones of the infants, and of the comparatively small number of old people, the apparent death-rate is actually diminished, instead of being increased as Letheby supposed. And this points to the true reason why the death-rate of France is higher than that of England, whereas the expectation of life in the two countries is about the same at most ages, the birth-rate of France being so extremely low (Bertillon). *The lower the average age of the population, the lower the death-rate.*

A considorable amount of emigration or immigration affects the death-rate in proportion to the average age of the migrants. Thus the mortality of most great and growing towns would stand worse than it does, were it not for the large numbers of young and healthy persons from the country who settle in them. Watering-places and residential towns appear somewhat healthier than they really are, by reason of the numbers of young domestic servants who form a large portion of their population. But it is in our colonies that the effect of migration on the death-rate can best be studied. The unexampled death-rate of New Zealand, already quoted, is the result of two kinds of causes, one set of which we may call real, the other factitious or apparent. The former are the cool, equable climate, and the orderly and comfortable condition of the population; the latter are the constant stream of mostly youthful immigrants, and the very high birth-rate.

Influence of Age and Sex.—The influence of age and sex on the mortality in England and Wales may be best shown in a tabular form.

Mortality per 1,000 at twelve groups of ages in males and females in the 41 years 1838–78:—

	All Ages	0–	5–	10–	15–	20–	25–
Males	23·3	71	8	4	6	8	9
Females . . .	21·2	62	8	4	7	8	9
		35–	45–	55–	65–	75–	85–
Males	23·3	13	18	32	67	147	311
Females . . .	21·2	12	15	28	59	134	287

The superiority of the women is here well-marked, except during childhood and the years of early married life and much child-bearing. And this difference has beon still greater during the later decados, owing chiefly to the decreasing vitality of males after the prime of life; thus in 1871–80 the death-ratc of males from 45 to 55 was 20, that of females only 15.

Influence of Race.—The influence of race is usually difficult to separate from that of habits of life. In Europe the Jews offer the most notable example. It may be sufficient to quote from Oesterlen Neufville's statistics of Frankfort-on-the-Maine, which show that there the average age of Christians at death was 36·9 years, but that of Jews was 48·7; and from Hoffman, the death-rate of tho Jows of Prussia, which was only 21·6 per 1,000, against 29·6 among the Christians.

Influence of Station and Occupation.—The influence of station and occupation on mortality is very great. The subject has been carefully handled by Dr. Farr in the Supplement to the Registrar-General for

[1] In 1890 the birth-rate in France actually fell to 21·6.

England's thirty-fifth *Report*, and again by Dr. W. Ogle, in the Supplement to the forty-fifth. Briefly, it may be said that of all trades or professions that can be isolated, clergymen, barristers, farmers, agricultural labourers, gamekeepers, and grocers seem to stand best in this respect. Booksellers, paper-makers, wheelwrights, and carpenters also suffer but a small mortality. Schoolmasters and teachers go on well up to fifty-five. Solicitors, domestic servants, watchmakers, shoemakers, and blacksmiths range not far from the average rates; so do bakers (though such is not the current opinion), and the whole tribe of weavers and most kinds of shopkeepers. The workers in iron, as a rule, experience but a low mortality in early life, but a high one as they grow older; the same may be said of millers, and, somewhat strangely, and no doubt for very different reasons, of Roman Catholic priests. Artists come out pretty well, musicians very badly. Tailors begin very ill, and end fairly. Medical men, alas! perish frequently in early life, and only attain a respectable position after fifty-five; the figures for chemists, also, are rather high. The figures for drapers, formerly bad, have improved of late years, as have those for commercial travellers. Those for miners, naturally enough, are not very different from those for iron-workers, except the tin and copper miners of Cornwall, who stand badly. Tobacconists, as might be expected, suffer very heavily until middle life. Printers, bookbinders, clerks, glass manufacturers, dock labourers, porters, railway employés, butchers, cabmen, draymen, and chimney-sweepers, all suffer a very high mortality. And about the worst positions are occupied by dealers in alcohol (brewers, innkeepers, and especially hotel servants) and in lead (painters), and by potters, cutlers, and filemakers.

These facts are of considerable practical interest in relation to questions of life insurance.

Mortality of Diseases.—Some acquaintance with the mortality of diseases, and the extent to which it is influenced by age, sex, climate, season, &c., is also of great value for prognosis. Information on this subject will be found under the heads of the several diseases; moreover, the limits of this article are not sufficient to admit of much discussion of the subject.

A few facts respecting the acute infectious diseases will, however, be of interest.

1. *Typhoid Fever.*—The average death-rate of enteric fever was put by Murchison, in accordance with British, French, and German hospital statistics, at 17·4 per cent. There is a good deal of ground for putting the average mortality of children and youths at 11 or 12, but it is probable that only the worst cases occurring in children find their way into hospitals. Over fifty years of age somewhere near one-half usually die (Liebermeister). The mortality from typhoid would appear, however, to be decreasing at a more rapid rate than the number of cases of the disease.

2. *Typhus.*—In typhus the mortality varies extremely in different epidemics, sometimes rising above the average of enteric fever, more often, perhaps, falling below it. In Ireland it is usually low, averaging probably 9 or 10 per cent., or less. The mortality of children from this disease is much lower than from enteric fever (Murchison, Lebert, &c.) The number of deaths ascribed to typhus (that is, continued fever, including enteric) in the register is, however, largest in proportion to the living under 5 years; is low from 10 to 15, and again from 25 to 35; and then increases gradually up to extreme old age. One cannot help suspecting that other febrile affections of children are confounded with typhus and enteric fevers.

3. *Measles.*—The mortality from epidemics of this disease is often as low as 2 or 3 per cent., but it has been known to rise to 30 per cent. under unfavourable circumstances, as where children, or even adults, are crowded together in a hospital. Among 'virgin' communities (as in well-known epidemics in Iceland, Färoe, Madagascar, Fiji) the mortality is sometimes frightfully large. It is comparatively small in summer; and decidedly small among the comfortable classes, owing doubtless to the exercise of greater care. It is beyond comparison greatest in the second year of life, and by the tenth has become quite trifling; but adults *may* die of measles.

4. *Scarlatina.* — There is a prodigious difference in the deadliness of different epidemics of this disease, even in the same locality. In Southern Europe it is comparatively a mild disease; in Britain it is most severe; yet even here eighty successive cases may occur without a death. But a mortality under 10 per cent. may be considered moderate (Thomas, in Ziemssen); it is often much higher. It is at its maximum from the second to the fourth year, but continues very deadly up to ten or twelve; by fifteen it has almost reached a minimum, but, unlike measles, continues to be somewhat formidable throughout life, especially to parturient women. Season and station in life make little difference in its deadliness.

5. *Small-pox.*—Small-pox did and does, in unvaccinated communities, where it has long been at home, destroy somewhere about 10 per cent. of the population; and of persons unprotected by vaccination who are attacked, 40 per cent. often perish. Among 'virgin' communities it is still more deadly. Age makes comparatively little difference in its fatality.

6. *Whooping-Cough.*—The death-rate of this disease is very large in the first year of life, declining afterwards like that of measles,

but rather more rapidly, and becoming quite insignificant before the tenth year. Whooping-cough is more fatal in winter than in summer, in towns than in the country, among the poor than among the rich; but these differences, except the first, are not very well-marked. JOHN BEDDOE.

MORTIFICATION (*mors*, death; and *facio*, I make).—A popular name for gangrene. *See* GANGRENE.

MORVAN'S DISEASE.—An affection met with especially in a district of Brittany, and named after the physician who first described it. The disease has strong points of resemblance to anæsthetic leprosy. It is a chronic affection, implicating the upper extremities more especially, and characterised by neuralgic pains, cutaneous anæsthesia, and painless and destructive whitlows. Well-marked neuritis and perineuritis have been found in the bodies of those dying of the disease; and in some cases these changes have been associated with syringomyelia. *See* SPINAL CORD, Special Diseases of: Syringomyelia.

MOTILITY, Disorders of.—The power of executing movements of the different parts, or of the body as a whole, may be interfered with in various ways; and as such disabilities are generally partial, the particular movements that happen to be implicated will also differ among themselves in different cases.

The disorders of movement to be referred to in this place are principally those in which the muscles of one of the limbs or of other external parts of the body are concerned—though disorders of the same kind, and also of different degrees, are likewise frequent, in which we may find perverted movements of viscera and their ducts, as well as of blood-vessels: in other words, portions of the involuntary muscular system are apt to have their functional activity deranged, after some of the same modes as portions of the voluntary muscular system.

In such cases, almost without exception—and to whichever class tho defects may belong—the disordered motility is due primarily to some defective or abnormal action of the nerve-centres or of the nerves in relation with the muscles implicated, rather than to any primitive disease of the muscles themselves.

CLASSIFICATION.—Disorders of motility are divisible into three primary classes, according as they show themselves (A) in responso to voluntary incitations; (B) in response to mere 'reflex' impressions; or (C) spontaneously. The particular muscles implicated (or the mode of distribution of the various defects) will necessarily differ much according to the extent and situation of the disease in the nerve-centres or in the nerve-trunks to which tho defects are due. In some cases particular defects of motility can be confidently referrod to disease of the brain, and even of particular parts thereof; in others they may be referred to disease of the spinal cord in particular regions; or, in other cases still, they may be as clearly due to some altered condition of nerve-roots or of nerve-trunks in their continuity.

A. **Disorders of Voluntary Movements.**—Under this head are to be included different varieties of disordered movement.

1. *Diminution of motor power.*—This varies much in degree in different cases. There may be mere weakness (paresis) or actual loss of power (paralysis) of one or more limbs, or of particular sets of muscles. The type of the paralysis will vary according to the seat and extent of the lesion. Thus it may be due to a cerebral lesion, and be of the hemiplegic type (*see* HEMIPLEGIA); or it may be due to a spinal lesion, and be of the paraplegic type (*see* PARAPLEGIA); or the loss of power may be owing to disease or injury of some nerve-trunk, and then be of the type of a peripheral paralysis, such as we get in facial palsy.

2. *Imperfect coördination of movements.* Here the several muscles concerned with the production of a given movement act without the relative subordination and gradation of force needful for its proper execution. Some muscles contract too powerfully and others not enough, or some contract too quickly and others too slowly, with the effect of producing a spasmodic or otherwise disordered movement—one by which the end desired is not readily attained. The condition thus produced is known as '*ataxia*,' of which there are two principal varieties—one caused by disease of the posterior columns of the spinal cord (*see* LOCOMOTOR ATAXY); and the other by disease of the cerebellum (*sec* CEREBELLUM, Lesions of). Ataxia is, in fact, a condition for the most part caused by the defects described in the previous category, together with that to be mentioned in the next, the two states co-existing (in different proportions in different cases) among muscles called into simultaneous or successive activity for the execution of various complex movements. A kind of ataxy may indeed be induced by more paresis in some muscles of a physiological group, that is of some muscles whose business it is habitually to act in combination with others.

3. *Spasmodic action of certain muscles.*—On volitional incitations reaching the spinal cord in certain statos of discase, some of the muscles whose contraction is to be brought about are thrown into a condition of over-action or tonic spasm, whereby the performance of the movement is greatly interfered with (*see* WRITER'S CRAMP). In such cases there is almost always in addition increased

reflex excitability, so that it is in some cases difficult to say how much of the spasm is primarily due to the volitional incitation, and how much to reflex spasms—caused by cutaneous impressions consequent upon the commencing movement. Some of these conditions are especially met with in cases where portions of the cord are cut off from the so-called 'inhibiting' influence of the brain, at the same time that there is hyperæmia, with increased excitability of the then active regions of spinal grey matter. This state of things is particularly frequent in 'primary sclerosis of the lateral columns.' On the other hand, the initiation of voluntary movements may, in other cases, give rise to clonic spasms in the parts moved, especially in certain cases of disseminated or insular sclerosis. *See* SPINAL CORD, Diseases of.

4. *Tremors, shakings, or choreic movements.* — Tremors (fine or coarse) and shakings are really clonic spasms of limited range; and all gradations may at times be met with between these several types of disordered movement. Such morbid movements of one or other grade, even if they exist more or less continuously, are usually increased by volitional incitations. This is the case, for instance, in the trembling from mercurial poisoning or from chronic alcoholism, as well as in that from senile changes; in the shakings met with in disseminated sclerosis; and also in the more irregular movements, often of wider range, characteristic of chorea. *See* CHOREA; SPINAL CORD, Diseases of; and TREMOR.

B. Disorders of Reflex Motility.—The conditions on which disordered movements, due to increase of reflex excitability, depend, have been above referred to. The withdrawal of brain-influence from, and the increased hyperæmia of certain tracts of spinal grey matter, seem to be the main causes, and these are met with principally in certain forms of paraplegia, and in spasmodic spinal paralysis, or primary sclerosis of the lateral columns. The mere weakening of cerebral influence will, however, lead to an increased manifestation of reflex movements, as may be seen in certain nervous or delicate persons, in infants, or in young children.

Two forms of reflex actions have to be discriminated, namely, those excited by cutaneous impressions—*skin reflexes*; and those induced by taps or slight blows upon tendons —*tendon reflexes* (*see* SPINAL CORD, Diseases of). Both forms are often unduly exalted in the same person, though sometimes the skin reflexes may be normal, whilst the tendon reflexes are greatly exaggerated.

Reflex movements of both kinds may be diminished, either (1) from disease of afferent nerve-roots outside or within the cord, as in tabes dorsalis; (2) from destructive disease of the grey matter of the cord, as in many cases of severe paraplegia; or (3) from disease of the motor roots or nerves supplying particular groups of muscles.

An increase or a diminution of reflex excitability is frequently met with, and is often of much importance, in connexion with one or other of the viscera, such as the heart, the stomach, the bladder, or the intestines. This undue nervous excitability may be dependent upon morbid conditions, partly of the bulb or spinal cord, and partly perhaps of some of the visceral nerves.

As possible conditions of much importance in the ætiology of many nervous affections, we may here also mention disordered activity of certain vaso-motor centres, capable either immediately or remotely of influencing the calibre of the blood-vessels supplying certain portions of the brain or cord. In this manner there might be induced either spasm of their vessels, with greatly lowered blood-supply; or paralysis of vessels, with consequent hyperæmia in such nerve-centres. These conditions would correspond with the death-like pallors or the flushings occasionally observable in the face or other tracts of skin. The doubt exists, however, as to how long such mere reflex pallors or flushings may persist in nerve-centres—that is, when they are simply due to functional defects. Are they always merely transient phenomena, or may they persist for days or even weeks, as some clinical facts would lead us to suppose?

C. Spontaneous Movements. — The movements which are manifested 'spontaneously' are various in nature or degree, though they are of kinds similar to those that may be excited by voluntary incitations. We need only enumerate these different varieties here, and briefly indicate either the diseases in which they are encountered, or the conditions on which they depend. (*a*) *Tremors*, such as present themselves in paralysis agitans, or mercurial poisoning. (*b*) *Twitchings*, or *startings*, occurring in one or more limbs, either upper or lower, in some cases of cerebral and of spinal disease. The more irregular but less spasmodic movements, known as (*c*) *choreic*, occurring principally in the disease from which they derive their name (being sometimes indefinite, and at others distinctly co-ordinated). (*d*) *Spasms*, which may be either co-ordinated, as in some cases of chorea; clonic, as in epilepsy, eclampsia, and other allied affections; or tonic, as in tetany, tetanus, strychnine-poisoning, and certain spinal affections, as well as in some cerebral diseases.

Conditions of *rigidity* and *contraction*, due to a more or less permanent tonic spasm, are scarcely to be described under the head of 'spontaneous movements,' since in such conditions, although there is powerful muscular contraction, there is no actual movement; and, similarly, the spontaneous *flickerings* of muscular fibres, seen in so

many cases of progressive muscular atrophy, deserve to be mentioned here, even though no movements are produced, owing to the small number of muscular fibres involved at any one time. The flickerings themselves are really clonic spasms involving a few fibres simultaneously.

Treatment.—The treatment of these different nervous conditions is considered fully under the various special articles to which reference has been made.

H. Charlton Bastian.

MOUTH, Diseases of.—The principal diseases of the mouth may be thus enumerated: (1) Inflammation and its results, including (1*a*) Thrush; (2) Gumboil; (3) Ranula; (4) Lingual Dermoids; (5) Salivary Calculus; (6) Salivary Fistula; and (7) New-growths and Epulis. Diseases of the tongue and the teeth are treated of in other articles.

1. **Stomatitis.**—Synon.: Fr. *Stomatite*; Ger. *Mundschleimhautentzündung*.

Definition.—Inflammation of the mouth.

Varieties.—Inflammation of the mouth may be *acute* or *chronic*. According to the more striking lesions found, we speak of *catarrhal*, *follicular*, *ulcerative*, and *gangrenous* stomatitis. Lastly, inflammations of the buccal mucosa may be classed according to their cause, for example, *syphilitic*, *scorbutic*, or *mercurial* stomatitis.

Ætiology.—Mechanical irritants such as a sharp tooth or a tooth-plate; chemical irritants, especially alcohol; burns and scalds, hot tobacco-smoke; mercurialism; the growth of parasites in the mucosa, such as thrush; the eruption of teeth, with accompanying digestive disturbances; some acute specific fevers; erysipelas, diphtheria, syphilis, and scurvy, are the principal causes of stomatitis.

Symptoms.—In *acute catarrhal* forms the mouth is hot; and the mucosa is more or less red, swollen, tender, and unduly sensitive to heat, salt, spices, and the like. All these changes are least marked upon the dense hard palate and gums. The secretion of mucus is increased, and it may form a tough slimy layer upon the surface, more or less turbid from contained epithelial cells and leucocytes. The excessive redness and raw appearance of the surface are largely due to the rapid shedding of the surface epithelium; but in less intense cases, white patches of all shapes and sizes indicate increased production of epithelium, the cells remaining adherent for some time. In the less intense forms, especially when of some duration, the mucous glands on the lips, cheeks, and palate swell and form reddish-grey nodules or even small cysts, often surrounded by a ring of injection. This is the form known as *follicular* stomatitis. Sometimes the follicles break down and form small ulcers. But there are certain forms of stomatitis, of which more or less extensive ulceration is characteristic. One of these is called, *par excellence*, *ulcerative stomatitis*.

Ulcerative stomatitis (putrid sore mouth) is not a further development of the above-described acute catarrh. It occurs chiefly in sickly children living under faulty hygienic conditions. After a slight febrile illness or malaise for two or three days, the child is noticed to eat with some difficulty, to suffer from more or less salivation, and to have a very foul breath. The cheek is perhaps swollen. On one side of the mouth, sometimes on both, one or more grey-based ulcers will be found upon the cheek, gums, and tongue. These may extend in depth till the alveolus is bare. No hard line can be drawn between ulcerative stomatitis and cancrum oris (*see* Cancrum Oris). If left alone, these ulcers generally heal in seven to fourteen days, but they may become chronic. Ulcers are very prone to form in stomatitis resulting from mercurialism, scurvy, or syphilis.

In *chronic catarrh* of the mouth the chief signs are undue sensitiveness of the mucosa, and the presence of white patches (leucoplakia). Fissures may form in these patches. This chronic epithelial overgrowth derives its chief importance from the fact that it is sometimes the forerunner of epithelioma. The chief causes of chronic catarrh appear to be smoking, dram-drinking, indulgence in hot spices, and syphilis; but frequently no cause is evident.

Treatment.—The avoidance of irritation, and the treatment of any general disease or digestive trouble, which may be regarded as a cause of the stomatitis, are the first points to be attended to. Food should be taken cool, and free from excess of salt or sugar, and from hot spices; alcohol and smoking should be forbidden. The feeding of infants at the breast and, still more, of bottle-fed children, should be inquired into, and all defects remedied. The mouth should be wiped out after each meal with a rag moistened with some mild antiseptic. Borax lotion or a little powdered borax, allowed to melt slowly in the mouth, is very soothing. In acute cases ice is grateful.

In *ulcerative stomatitis*, chlorate of potassium should be given internally with due care, and used also as a gargle. It is almost a specific. Borax lotions are useful; and it is well to begin the treatment by wiping the ulcer and thoroughly applying 1 in 1000 lotion of perchloride of mercury. This may be repeated daily. Finely powdered iodoform should be occasionally dusted on the sore. The hygiene of the mouth and of the whole body should be cared for. Change of air is most valuable. Nitric acid or ammonia and bark form an excellent tonic; and cod-liver oil and iron are generally useful later.

In *chronic leucoplakia*, treatment in syphilitic cases should include painting the

patches with a lotion of bicyanide of mercury (gr. ij.–v. ad ℥j.) In simple cases they should be painted with bicarbonate of potassium (gr. xx. ad ℥j.), or chromic acid (gr. v.–x. ad ℥j.), the latter solution to be used every second day.

1*a*. **Thrush.**—Synon.: Fr. *Muguet*; Ger. *Soor*; *Schwämmchen.*

Thrush is a parasitic stomatitis which occurs chiefly in young infants, and usually in such as are depressed in health, congenital syphilis thus ranking as a predisposing cause. It is not, however, rare to find infants in good health attacked. Adults do not, as a rule, suffer from this parasite, except towards the end of exhausting illnesses, especially phthisis; so the appearance of thrush in adults is usually an evil omen. Rarely a non-parasitic stomatitis or sore-throat depresses the mouth-tissues of adults sufficiently to allow the parasite to grow.

The thrush parasite is the *oidium albicans* (fig. 110), discovered by Gruby in 1842. Its exact nature seems still to be doubtful. It is *not* the oidium lactis, as formerly supposed; and Grawitz's statement that it is the *saccharomyces mycoderma*, or mould of wine,

Fig. 110.—Oidium albicans, or Saccharomyces mycoderma.

is generally received as correct. It affects mucosæ covered with stratified epithelium, especially that of the mouth and fauces; it is not uncommon in the pharynx and œsophagus, but is rarely found growing lower in the alimentary tract. It is sometimes found growing in broncho-pneumonic foci, having been inhaled. The parasite grows in the middle layers of stratified epithelial laminæ, and consists of numerous mycelial threads mixed up with spores and fine granular *débris*. The neighbouring epithelial cells are destroyed and ultimately thrown off, leaving what looks like an ulcer; but almost always the deepest layer of epithelium remains covering the papillæ.

Symptoms.—It is said that the first sign of thrush is some general heat and redness of the mouth, together with the secretion of a sticky layer of mucus of *acid* reaction, and containing many cells, among which spores and threads are already recognisable. Then small white roundish patches form, and run together into larger ones. The patches are surrounded by a vascular ring. At first they are pretty firmly adherent, later on easily detachable, leaving 'ulcers.' Sucking may become painful. More or less disturbance of the gastro-intestinal functions is usually present. Mothers suckling children with thrush are very liable to sore nipples.

If the above be taken as the typical symptoms of thrush, we must add that in many cases the parasite excites no inflammatory phenomena whatever, suggesting a parallel with tinea tonsurans, which also may or may not cause inflammation.

Thrush is commonly said by mothers 'to go through' children. This means that, whilst thrush is present in the mouth, and the child is perhaps suffering from gastro-intestinal symptoms, redness, excoriation, and perhaps ulceration appear at the anus, and spread more or less widely to adjacent parts. Some think that in the child's depressed condition of health any tendency to intertrigo or eczema would show itself, and that acrid evacuations would render the anal region specially liable; but in the writer's opinion the above history is very strongly in favour of congenital syphilis, and he finds that treatment generally supports this view.

Treatment. — Care in feeding children regularly at proper intervals, in the selection of milk and preparation of food for hand-fed children, scrupulous cleanliness with regard to bottles, spoons, &c., used in feeding the child, and especially the precaution of wiping out a child's mouth thoroughly after each meal with rag or wool wet with glycerine of borax, make up a highly successful prophylaxis against thrush. When the trouble is present, all these precautions must be carefully observed, and a food suitable to the patient must be found. Gastro-intestinal symptoms must be relieved. The patches of thrush in the mouth and throat should be frequently painted with glycerine of borax, the B.P. solution of sulphurous acid (1 in 6 of water), salicylic acid solution (1 in 250), sulphite of sodium solution (ʒj. ad ℥j.), or almost any other non-irritant antiseptic. Good hygienic surroundings, change of air, and supporting treatment are often necessary to bring about the recovery of feeble patients, and are helpful to all.

2. **Gumboil.**—Synon.: *Parulis*; Fr. *Parulie*; Ger. *Zahnfleischgeschwür.*

Description.—A 'gumboil' is a small abscess pointing upon the gum. The term

'alveolar abscess' includes all gumboils and many other cases; for, whilst indicating that such abscesses almost invariably start in the alveolus or socket of a tooth, it says nothing as to their pointing, the directions in which they tend being very varions.

The canse of an alveolar abscess is almost invariably caries of the tooth in connexion with which the abscess arises. The irritant is therefore most probably some septic organism which gains entrance to the pulp-cavity and excites an inflammation of the pulp, which spreads along a fang. Usnally the whole tooth dies as a result. An abscess may form at the base of a tooth already dead, though not carious, the irritant probably entering between the socket and the tooth, but not necessarily, for an abscess is rarely found connected with a sound living tooth, and the pulp of a sound (though dead) tooth may be found putrid. An abscess occasionally arises in connexion with a partially erupted tooth, especially a wisdom-tooth in the eruption of which there is difficulty; or, again, a cyst round a retained tooth may suppurate and resemble an ordinary alveolar abscess.

In the ordinary alveolar abscess pns is formed about the apex of the fang within the alveolns, whence the acute early pain. The bone around the apex of the fang is rapidly softened; and the *outer* plate of the jaw, being decidedly thinner than the inner, yields, and the pns escapes into the tissues outside the jaw. More or less swelling of the face now occurs, and, coincidently, diminution of pain. The pus then forces its way towards the surface in the direction of least resistance, and very often bursts on the gum, or between this and the cheek. But this is by no means always the result, the point of bursting being sometimes so distant from the seat of irritation that the latter runs some risk of remaining unrecognised. The following, more or less, unusual points are therefore noted. Abscesses from the npper incisors may not uncommonly burrow between the hard palate and its coverings, and open far back; rarely they burst into the nose, causing a discharge from the nostrils; and still more rarely through the lip. The palatine roots of the upper molars may also canse a palatine abscess; whilst pus starting from the external fangs is sometimes condncted, apparently along the bnccinator fascia, to the cheek, where it bursts. Affection of, and suppuration in, the antrum is most likely to result from the first upper molar fangs; but disease of any upper tooth, especially molar or bicnspid, may be the cause of continued suppuration. Abscess from the lower incisors rarely bursts on or below the chin. Abscess from the lower molars and bicuspids, more commonly than from any other teeth, bursts upon the face. From the lower wisdom-tooth an abscess may burst far back npon the fauces, near a molar or bicuspid, or below the jaw. In a few cases the pus of these latter abscesses has burrowed, from insufficient drainage, down the neck, even as low as the clavicle. Rarely an abscess from a lower molar finds its way through the *inner* plate of the jaw.

Symptoms.—At first the tooth appears too long (from periostitis); and is the seat of pain, which is relieved by pressure npon the tooth. Soon it becomes so tender that all pressure is unendurable, and pain increases rapidly, often becoming very severe. After twenty-four to forty-eight hours the pain diminishes or disappears, and the face swells more or less. Finally the abscess, if left to itself, bursts. It may discharge freely through the opening, and sometimes through and around the tooth. Sometimes it undoubtedly heals, and the tooth remains firmly fixed, or a sinns may remain, giving little trouble if it open into the mouth, mnch disfigurement if on the face, or frequent abscesses may form. Abscess from a non-erupted or carions wisdom-tooth is specially likely to be accompanied by chronic trismus. Grave results, such as death from pyæmia, are very rare.

Treatment.—An acute alveolar inflammation may be aborted by disinfecting the tooth-cavity with pure carbolic acid, scarifying the gum, and applying freqnent hot fomentations to the month. Where the above treatment fails to relieve the early acute pain (toothache), pus not having yet made its escape from the alveolns, extraction of the tooth (discovered by smart tapping with a steel instrument if the patient cannot clearly indicate which is aching) is the best remedy. When the tooth is valuable, Tomes has suggested that an incision should be made down to the bone opposite the diseased tooth, and the outer plate of the jaw drilled at the level of the apex of the fang—not a very painful operation, he says. When abscess is present and the tooth of little or no valne, removal of the tooth often provides sufficient drainage; but if the patient cannot be easily watched, an incision also should be made into the abscess between the cheek and jaw, especially as, with cocaine, it adds nothing to the pain. This incision should always be made immediately when the abscess is threatening to burst through the skin; also when pus is stripping up the soft parts from the hard palate. The skin over the pns may then be painted with flexile collodion, and elastic pressure maintained with a bandage over cotton-wool. Thinned red skin may thus often be preserved. When bursting through the skin seems inevitable, it should always be anticipated by a short incision, through which a fine tube may be introdnced. The result of this will be a much in-drawn scar, but in the course of months the depression diminishes till it may become hardly noticeable. In making

incisions between the jaw and cheek, the points to be attended to are to use a small scalpel, cut close and parallel to the jaw, and direct the point a little towards the bone. The presence of pain and swelling are reasons for the immediate performance of extraction, and not for its postponement till these symptoms shall have subsided. In all chronic sinuses of doubtful nature about the mouth, lower part of the face, or neck—even as low as the clavicle—the teeth should be carefully examined and put in order. It will probably be useless to endeavour to save a tooth which has given rise to chronic sinus or to recurrent abscesses. Even after removal of the tooth and gouging of the alveolus, the sinus may remain for months, but ultimately close. An opening upon the face may in these cases close if a probe be passed along the sinus and freely cut upon from within the mouth. To preserve a tooth, the pulp-cavity is to be emptied and rendered aseptic, and then it and its prolongations must be filled. If the process is successful, the tooth heals in as does a clean foreign body; if it fail, fresh abscesses form and extraction becomes necessary. *See* TEETH, Diseases of.

3. **Ranula.**—SYNON.: Fr. *Grenouillette*; Ger. *Ranula*; *Fröschleingeschwulst*.

DESCRIPTION.—Ranula is a cystic swelling situate more or less upon one side of the frænum linguæ, rarely upon both sides; affecting both sexes at all ages, but chiefly occurring in adult life. It is not uncommonly referred to an injury after which it has appeared; it increases slowly, rarely becomes larger than a chestnut, is painless, and causes inconvenience only by its size. The swelling in the mouth is smooth, rounded, tense or soft, elastic or fluctuating, and has a bluish pellucid appearance strongly suggestive of its cystic nature. The mucosa is non-adherent and free from folds over the swelling, across which tortuous veins often wind. Only with ranulæ of exceptional size is any swelling perceptible below the jaw.

PATHOLOGY.—This is doubtful, and several modes of origin have been described. Distension of Wharton's duct may certainly occur, but in the majority of cases this duct is clear, and a probe introduced passes over the swelling. Wound of the duct and extravasation of saliva may cause the appearance of a cystic swelling. Some believe that the sublingual gland and its principal duct (Bartholin's) are the chief seats of ranula, but this is unlikely. Fleischmann's bursa—on each side of the frænum, between the mucosa and the muscles—is probably sometimes the seat of a pathological effusion. Dilatation of a mucous gland may occur beneath the tongue, especially that known as the Blandin-Nühn gland from the names of its describers. This was found adherent to the cyst by von Recklinghausen and Sonnenberg in one instance, and they adduced many good reasons for thinking that this gland was, at least, a very common seat of the cystic distension known as ranula.

TREATMENT.—A thick silk seton may be tied and remain in for three to seven days, according to the degree of irritation excited; this may be serious, and run on to abscess. Other methods of treatment are (*a*) opening the cyst freely, drying it out, applying pure carbolic acid, and packing with iodoform gauze; (*b*) cutting a V-shaped flap in the wall, and fixing its apex into the cavity with a stitch; (*c*) dissecting out the whole cyst, or the superficial part of it, upon which the Blandin-Nühn gland would lie (von Recklinghausen). Dr. Woakes reports a cure from the injection of a saturated watery solution of chromic acid.

4. **Lingual Dermoids.** — DESCRIPTION. Lingual dermoids occur in two situations—in the mid-line between the genioglossi, and on either side of the tongue, between the genioglossus and mylohyoid. They are rare, and are due to the inclusion of an epithelial germ connected either with the invagination of the mouth-pit or stomatodœum, the closure of the first visceral arch or of the first branchial cleft, or with the fœtal ductus thyroglossus (His), which extends from the foramen cæcum of the tongue to the thyroid isthmus, and is regarded as the remains of the hypopharyngeal diverticulum or protrusion from the foregut to form the thyroid body. Cysts between the genioglossi and in the mid-line of the neck, as low as the thyroid isthmus, are probably connected with the ductus thyroglossus, or with the union in the mid-line of the upper branchial arches; cysts on either side of the mid-line with closure of the branchial clefts or with the junction of the stomatodœum and foregut. The contents vary, being sometimes the usual cheesy, epithelial mass, with or without pale hairs intermixed; sometimes only a brownish mucoid fluid, in which float small masses of fatty epithelium. The lining of the cyst is generally a delicate layer of stratified epithelium, derived, it is thought, from epiblast; but it has lately been suggested that some of these cysts, especially those with mucoid contents, may be derived from hypoblast.

Though really congenital in origin, and usually reaching a size to attract notice in early life, these cysts often remain small for many years, and then, without obvious cause, begin to enlarge. They may not appear until mid-life or even later. They form smooth, round or oval, tense, elastic and fluctuating, or doughy swellings beneath the tongue, in the mid-line or on one side; they are usually firmer to the touch than ranulæ; unlike ranulæ they project chiefly towards the skin and but slightly into the mouth, the mucosa over them being normal unless some dilated veins ramify in it; they never have the translucent appearance of ranulæ, but it

is said that some have a yellowish appearance owing to the colour of the sebaceous stuff showing through. They cause inconvenience in proportion to their size.

Treatment.—This consists of complete removal by dissection, when inconvenience or unsightliness renders treatment desirable. The incision should be made on the most prominent part of the cyst within the mouth *right down to the cyst-wall.* Traction with forceps upon the cyst and occasional touches with the knife will now generally suffice. If large, the cyst may be opened and emptied. If still more room is required, we must incise through the skin on to the most prominent piece of the swelling. When no mouth-incision is made, the wound may be treated aseptically. A wound in the mouth should be sponged with chloride of zinc solution (gr. xx. ad ℥j.) and freely dusted with iodoform; subsequently the mouth must be frequently washed with boric acid or borax lotions, and ice may be constantly sucked if inflammation tends to ensue.

5. **Salivary Calculus.** — Synon.: Fr. *Calcul Salivaire*; Ger. *Speichelstein.*

Description.—Friable concretions, composed chiefly of phosphate of lime, are not very uncommon in the ducts of the parotid, submaxillary, and sublingual glands. They vary in size from a pin's head to a filbert, or even larger, are elongated in form, and not infrequently they form around some small foreign body—a seed or a bit of woody fibre—which has made its way into the duct. They may lie in the substance of the gland, but are usually found in the duct. They are easily felt from the mouth, but are rarely complained of unless they give rise to the following symptoms. Without obvious cause inflammation causes complete or partial obstruction of the duct; the gland swells and becomes hard, but is neither tender nor painful as a rule. In the case of the submaxillary duct, the side of the tongue and floor of the mouth are red, and more or less swollen; an abscess may form in the latter situation.

Treatment.—If a concretion can be felt, either with a finger or with a probe passed along the duct, an incision should be made on to it, and the calculus removed with care, lest it break and the fragments excite more inflammation than did the entire mass. Local inflammation requires a poultice outside, and constant fomentation of the mouth with hot boric acid or borax lotions; if an abscess form it should be opened and treated similarly.

6. **Salivary Fistula.**—Synon.: Fr. *Fistule Salivaire*; Ger. *Speichelfistel.*

Description.—Occasionally the duct of the parotid gland (Steno's duct) is wounded or involved in an ulceration, or an abscess forms in its track and bursts externally. In such cases a salivary fistula is likely to be the result. The secretion from the parotid instead of making its way into the mouth dribbles over the cheek.

Treatment.—Whenever the parotid duct is involved in a wound of the cheek, an opening opposite the wound should be made into the mouth; the duct should be most carefully sutured, as also should be the tissues superficial to the duct. When a fistula has formed, all ulceration should have ceased for weeks or months before any operation is undertaken for its closure. The first point in all operations for established fistula is to secure a free drain into the mouth for saliva, either by dilating the distal end of the duct with catgut threads, or by puncturing the mucosa of the cheek in two places from the depth of the fistula, and passing a stout bit of silver wire through the holes and tying it in the mouth. The closure of the opening in the skin has been effected by light cauterisations; by paring the edges, dissecting up skin flaps for some distance and bringing them together; or, best of all, by removing the edges and adjacent skin and twisting in a flap to fill the gap. A small wool dressing should be applied after either of these operations, and kept in place by a truss; all movement of the cheek should be avoided.

7. **New-Growths.**—Most of these start from the tongue or jaws. Papillomata and epitheliomata are not uncommon on other parts of the mouth also; they present their usual characteristics, and are treated by removal. The swollen mucosa round a sinus, leading to a sequestrum of the hard palate, sometimes presents a striking resemblance to an epithelioma.

Epulis. — Synon.: Fr. *Épulide*; Ger. *Epulis.*

Description.—'Epulis' is a somewhat loosely used word applied to tumours projecting upon the gum. Without an adjective indicating the nature of the growth, it really conveys nothing beyond the situation of the mass; but custom has practically limited its application to two common and often clinically indistinguishable pathological varieties, the fibrous and the myeloid.

These tumours spring from the fibrous tissues of the gum, or from the alveolar periosteum and bone—the myeloid growths always, and fibrous usually, having a connexion with bone. Sometimes small growths of the latter nature come away attached to the fang of an extracted tooth, as if they had originated from the fibrous covering of the fang.

Epulides are commoner in connexion with the lower than with the upper jaw. They form smooth, rounded, or lobulated masses, usually quite sessile, varying from pinkish-white through red to purple-red in colour, and firm or semi-elastic to the touch. They are covered at first by the epithelium and mucosa of the gum, but ultimately they may ulcerate from

pressure against the teeth or other irritation. Most commonly they present between two teeth, displacing one or more; or they may project upon either the superficial or the deep surface of the alveolus—the latter but rarely. Growth is not very rapid, and there are no signs of deep infiltration of the jaw.

Treatment.—This consists in free removal of the growth, together with any bone in connexion with it. Sometimes this may be effected under cocaine, especially with growths on the superficial surface of the gum; in other cases an anæsthetic is necessary, two or three teeth must be extracted, and the whole thickness of the alveolus cut away with a small saw and bone-forceps. After such treatment, recurrence is unusual; but myeloid growths sometimes show exceptional malignancy, and require specially free handling.

Stanley Boyd.

MOVABLE KIDNEY.—*See* Kidneys, Diseases of.

MOVEMENT, Therapeutical Uses of.—Synon.: Movement Cure; Kinesitherapeutics; Fr. *Gymnastique Suédoise*; Ger. *Kinesitherapie*.

Description.—The method of treatment of disease by movement appears to have been first designed by Ling, a member of the Royal Swedish Academy, about the beginning of the present century. The movements employed are said to be of three classes, namely: (1) *active movements*, executed by the patient himself, or by the patient aided by an assistant; (2) *passive movements*, performed by the assistant on the patient; and (3) *acts of resistance to movements*, whether executed by the assistant against the patient, or by the patient against the assistant.

Uses.—The several classes of movements, for which mechanical arrangements are also contrived, when scientifically employed, are used in the treatment of paralysis, curvatures of the spine or limbs, and injuries and diseases of the joints. Movements of the nature of friction or shampooing are also employed in the treatment of certain diseases of internal organs. *See* Friction; Massage; and Shampooing.

MOXÆ (Eastern).—A term for a form of counter-irritation, which consists in producing an eschar by burning certain materials upon the skin of a part. Moxæ were originally prepared in Eastern countries from the leaves of the artemisia; but when they are used in this country, cotton-wool and like substances are employed. *See* Counter-irritants.

MUCOID DEGENERATION.—A form of degeneration, which is associated with the production of a mucus-like substance. *See* Degeneration.

MUCOUS MEMBRANES, Diseases of.—This class of membranes, which line organs and passages communicating with the exterior of the body, though presenting modifications as to their minute structure in different parts of the body, exhibit a general resemblance in their construction, and consist essentially of submucous tissue; a basement-membrane; epithelium of various kinds covering the free surface; and numerous glands or follicles, differing in their characters in different tracts. They are highly vascular as a rule; and many of them are richly provided with absorbent vessels. The present article is intended to treat briefly, from a general point of view, of the morbid conditions to which mucous structures as a class are liable. Those connected with the several mucous tracts are discussed under their appropriate headings.

1. **Injury.**—Most of the mucous surfaces are exposed to injury from various causes. This may come from without, the cause being either mechanical, chemical, or excessive heat. As illustrations may be mentioned injury to the mucous lining of the alimentary canal or air-passages by foreign bodies; corrosion from swallowing strong acids; and burning or scalding of the mouth or of parts lower down, in consequence of inhaling a hot blast or swallowing boiling water. In other cases the injury may originate within the body, as by calculi passing along tubes or lodged in cavities lined by mucous membranes; hardened fæces in the intestines; parasites; or the rupture of enlarged veins, aneurysms, or abscesses into mucous cavities.

The effects of an injury to a mucous surface differ much in their nature and extent, according to its cause. Thus there may be a mere contusion; a superficial erosion or abrasion; a more or less extensive wound or rupture, other structures being then also involved; a burn or scald; or actual destruction by corrosives. More or less inflammation is liable to follow injury to a mucous surface. Subsequently ulcers may be produced, which by their cicatrisation may give rise to constriction or actual obliteration of tubes, and other untoward consequences.

2. **Hyperæmia and Anæmia.**—The mucous membranes are very prone to become the seat of congestion, either active, mechanical, or passive. *Active hyperæmia* may be a part of a physiological process, as is seen in the gastric mucous membrane during the process of digestion. Any slight irritation may also cause it, and it is scarcely practicable to indicate a distinct line of demarcation between this condition and inflammation, of which active congestion constitutes the earliest stage. It is characterised by bright redness, new vessels frequently coming to view; and at first by a tendency

to dryness of the affected membrane, which may be followed by excessive and altered secretion. *Mechanical congestion* is often an important morbid condition in connexion with mucous structures, giving rise to troublesome symptoms. For instance, in cases of cardiac disease, obstructing the pulmonary circulation, the mucous lining of the air-passages becomes more or less congested permanently; and if the general venous circulation becomes overloaded from a similar cause, other mucous tracts suffer, especially that of the alimentary canal. This tract is also directly involved in cases of portal obstruction. Particular portions of a mucous membrane might become the seat of mechanical congestion, if some local vein should become obstructed from any cause. The effects of this condition are in the first instance to make the colour deeper, with a more or less venous hue; and at last the small veins may be evidently dilated and varicose. The secretion becomes modified in quantity and quality, and in time a permanent discharge is likely to be established, consisting of an unhealthy thick and tenacious mucus; while the proper secretion of special glands, such as the gastric juice, is interfered with. In some instances mechanical congestion gives rise to an abundant flow of a watery mucus. The membrane itself is also liable to become altered, being swollen at first; and ultimately it may become permanently thickened and firmer than normal, owing to increase of connective tissue, while its own special structures degenerate. Hæmorrhage may occur as the result of venous congestion of a mucous surface, especially if the vessels are permanently distended or varicose. *Passive congestion* may follow inflammation of a mucous membrane; or it occurs in persons of relaxed and feeble habit; or follows excessive use of a part covered with a mucous membrane, as in the case of the throat.

Anæmia in connexion with a mucous membrane is important only when this is a part of general anæmia from any cause. Those mucous surfaces which are visible, such as the conjunctivæ, the lining of the mouth and lips or the gums, give the most striking evidence of this condition, as indicated by their pallor or actual bloodlessness. An anæmic condition of the alimentary canal probably interferes in an important degree with the functions of its mucous membrane, and with the formation of the secretions which it normally produces.

3. **Inflammation.**—Various forms and degrees of inflammation are of very common occurrence in connexion with mucous membranes, and a large number of cases in ordinary practice belong to this class. Without entering upon any description, it will suffice to state here that the inflammation may be acute, sub-acute, or chronic; and either catarrhal, croupous, or diphtheritic in character (*see* INFLAMMATION). Different tracts of membrane present different degrees of liability to these several forms of inflammation; and the catarrhal form not only has various grades of intensity, with corresponding variety in its products, which may become muco-purulent or actually purulent, but these products also differ in their nature in connexion with different membranes of the mucous class. Further, inflammation from special causes, such as gonorrhœa, is characterised by running a more or less definite course, and forming special products of an infective nature. When the inflammation is of a severe type, it may end in more or less destruction of the mucous tissues, as indicated by erosion, ulceration, or even gangrene. Where the submucous tissue is loose, œdema is very liable to occur. From this cause, as well as from thickening of the mucous membrane itself, from a plug of mucus, or from a croupous or other deposit on the surface, narrowing or even actual closure of any tube or passage lined by such a membrane is apt to be produced, especially at its orifice. Inflammation may also give rise to submucous suppuration. When the inflammation is chronic, permanent changes are set up in mucous tissues, the normal elements being altered or entirely removed, and a fibroid material being formed in course of time, so that the membrane is rendered permanently thickened and tough.

The cause of inflammation of a mucous membrane may be *local*, including injury, mechanical or chemical irritation, or that resulting from undue heat or cold, morbid products or growths; or *general*, such as chilling of the body from 'a cold,' or blood-poisoning in connexion with fevers and other conditions; or the inflammation may be a manifestation of some *specific disease*—for instance, diphtheria or gonorrhœa. Some mucous tracts are particularly liable to be affected under certain predisposing conditions, and at certain periods of life. Thus, bronchitis is very common in children and old persons; while the former are also exceedingly subject to catarrh of the membrane lining the alimentary canal.

4. **Ulceration.**—Ulcers are of common occurrence on mucous surfaces. They usually result from injury or inflammation; or are the effect of certain special morbid processes, as in the case of typhoid fever, syphilis, tubercular disease, cancer, dysentery, scarlatina, or diphtheria. Ulceration may exceptionally depend upon destruction of the tissues by parasitic growths, as in some cases of thrush, or in actinomycosis. Some pathologists believe that ulceration of a mucous membrane occasionally arises from embolic plugging of arteries, and consequent death of a limited portion of this membrane, which separates, leaving an ulcer. In the

case of the stomach it has also been supposed that under certain circumstances the gastric juice may so act upon the mucous lining as to destroy it. A peculiar form of ulcer is sometimes observed in the duodenum after severe burns. Ulceration of a mucous membrane often begins in connexion with the glandular structures; this may be due in the first instance to mere blocking up of their orifices, leading to accumulation of their products and subsequent inflammation; but certain special morbid processes commence in these structures. Inflammation may cause ulceration, either by directly destroying the membrane rapidly or gradually, or by setting up submucous suppuration.

Mucous ulcers differ much in their seat, extent, depth, shape, and other characters, according to their nature and cause. The simple forms are either mere erosions, or of the catarrhal or follicular varieties; and in each of the special diseases already mentioned the ulcers present peculiar characters. Occasionally they assume a gangrenous condition. If an ulcer extends deeply, it involves other tissues besides those of the mucous membrane, and may thus lead to perforation of cavities or tubes, and other untoward consequences. It not uncommonly gives rise to hæmorrhage. Cicatrisation often takes place, and this may lead to permanent contraction, stricture, or even complete closure of channels lined by mucous membranes, with more or less thickening and induration. Ulceration frequently destroys the glandular structures, which are not afterwards renewed.

5. **Gangrene.**—Occasionally the tissues forming a mucous membrane mortify, as the result either of severe injury, corrosion, inflammation, or vascular obstruction. The gangrene is of the moist kind, and the dead tissues may separate in a mass or in shreds. Consequently an ulcer is left; or actual perforation of a tube or hollow organ may take place.

6. **Nutritive Changes.**—*Hypertrophy* of mucous tissues is sometimes seen, but this may appear to be the case when it is not really so, the membrane being thickened and firm, owing to chronic inflammation, and the formation of fibrous tissue. *Atrophy* is not uncommon, especially of certain of the elements of mucous membranes, such as the glands or epithelium. *Degeneration* is also often observed, affecting these and other structures. This degeneration may be of a senile character; or of a special kind, such as albuminoid or mucous degeneration. Not uncommonly mucous tissues are relaxed and deficient in tone, their nutrition being impaired.

7. **Deposits and New-Growths.**—The chief new-formations observed in connexion with mucous membranes are polypi, villous growths, epithelioma, and tubercle. Syphilitic gummata may involve these membranes. Malignant growths may originate in connexion with certain mucous membranes or the submucous tissue, and epithelioma often starts from a mucous surface. Cysts occasionally form, originating from the glands or epithelial structures. The peculiar eruptions of some of the exanthemata may occur on mucous surfaces, especially small-pox; and also herpes. Certain animal or vegetable parasites are often associated with mucous membranes, and actinomycosis demands special notice in this connexion. *See* Actinomycosis.

8. **Special Diseases.**—It will suffice to remark under this head that in certain diseases mucous membranes are particularly affected, such as typhoid fever, diphtheria, measles, scarlatina, and dysentery.

Symptoms.—The symptoms which may arise in connexion with one or other of the diseases affecting mucous membranes just indicated, are of the following nature :—

1. *Morbid sensations*, usually of a more or less painful character, are often experienced. These will vary in degree and kind, not only with the nature of the disease, but also with the particular mucous surface which happens to be involved, some being much more sensitive than others. Painful sensations are chiefly met with in connexion with injury, inflammation, ulceration, or malignant disease, and they will be localised in accordance with the seat of the mischief. As a general rule, it may be stated that the sensation is one of heat or burning, rawness, or soreness; and it is usually much increased by any direct irritation of the affected surface, to which mucous membranes, from their situation, are specially exposed. Sometimes the morbid sensation consists in a feeling of tickling, itching, or undue irritability and sensibility to sensory impressions, such as those of heat and cold. It must be borne in mind that serious lesions of mucous surfaces, which, as a rule, cause marked pain, may exist without producing any such effect.

2. *Hæmorrhage* from mucous surfaces is of common occurrence, the amount of blood lost varying from a mere trace to a quantity sufficient to cause death. The bleeding may apparently take place quite spontaneously, and without any evident cause, as in some cases of epistaxis; or it may be associated with congestion, injury, inflammation, ulceration, gangrene, new-growths, or other conditions.

3. *Morbid products* are very frequently formed on mucous surfaces, or the normal secretions are modified in quantity or quality. Thus, the mucus may be deficient or excessive; and either thin or watery, unduly viscid and adhesive, modified in its reaction, or otherwise altered. A free serous flow may take place from a mucous membrane, as the result of congestion or catarrh. Muco-

purulent matter, actual pus, and croupous or diphtheritic membrane, are among the chief morbid products formed in connexion with mucous surfaces. Not only do these materials reveal their presence by being discharged externally in various ways, but they may themselves cause additional symptoms, by affecting substances with which they come into contact. For instance, in the alimentary canal unhealthy mucous secretions often lead to fermentation and decomposition of food, with their consequences; and similar effects are produced on the urine by morbid products formed in the renal pelvis or bladder. Some mucous discharges are also themselves irritating, and affect injuriously the surfaces over which they pass, causing pain, or setting up secondary inflammation. Gangrenous tissues may also be separated.

4. *Expulsive actions* of different kinds are often excited by morbid conditions connected with mucous surfaces lining passages and organs. These may be illustrated by sneezing, coughing, vomiting, undue action of the bowels, and frequent micturition. They may result merely from excessive sensibility or irritability of the membrane; or from the presence of blood, or of the morbid materials already mentioned, which need to be got rid of.

5. The *special functions* of certain mucous membranes are very liable to be interfered with when they are affected in various ways, especially in consequence of changes in the epithelium and glandular structures. This may be best illustrated by the alimentary canal, where dyspeptic symptoms often arise from changes of this character, the secretions necessary for the process of digestion not being properly formed; and the function of absorption by the intestinal wall is not uncommonly more or less imperfectly performed.

6. *Obstruction* or *contraction* of tubes or orifices lined by mucous membranes may arise from inflammatory or hypertrophic thickening, submucous œdema or suppuration, inspissated secretion, cicatrisation of ulcers, or some forms of new-growth. The consequent effects and symptoms are similar to those from other forms of obstruction, such as dysphagia when the œsophagus is affected, dilatation of the stomach from obstruction of the pylorus, retention of urine when the urethra is involved, or some form of dyspnœa when the air-tubes are obstructed.

7. *Physical examination*, particularly by *inspection*, at once reveals the condition of mucous surfaces which are visible. This may be aided by suitable instruments in the examination of parts which are situated more internally. Special modes of examination give us important information as to the diseases of certain mucous membranes, such as that lining the air-tubes, the gastric surface, or the interior of the bladder.

8. *General symptoms.*—Diseases of mucous membranes are often accompanied with symptoms affecting the general system. The most obvious of these are fever and wasting, which may arise from various causes. Pyrexia is not as a rule high in connexion with inflammation of mucous surfaces. It must be remembered that certain affections of this class of membranes are but manifestations of some general or constitutional disease, which presents its own symptoms.

Treatment. — The general principles or indications in the treatment of diseases of mucous membranes may be summed up as follows: 1. To relieve pain and other sensations by appropriate means. 2. To check hæmorrhages, if they are in such amount as to need interference. 3. To subdue inflammatory action. 4. To brace up and give tone to relaxed tissues. 5. To influence secretions and morbid products, increasing or diminishing the former, checking or modifying discharges, and endeavouring to affect special materials, such as diphtheritic deposits. 6. To allay undue excitability which tends to cause violent actions; to aid such actions as may be necessary to expel excessive excretions or morbid products; or in other ways to prevent their accumulation. 7. To supply the place of, and prevent the symptoms resulting from the want of secretions necessary for special purposes, which are formed by certain mucous surfaces, such as the gastric juice. 8. To treat particular morbid conditions, such as ulcers, gangrene, new-growths, or constriction, with the view of curing them. 9. To treat general symptoms.

Local applications, or such remedies as when administered internally come into contact with the affected surface, whether directly or after absorption, are of much value in the treatment of diseased mucous membranes. These may be anodyne, sedative, caustic, stimulating, astringent, demulcent, antiseptic, or of other kinds, according to the action required; and they are often advantageously applied in special ways. Operative procedures are not infrequently required. *General* treatment is often of the greatest service in the management of diseases of mucous membranes, and this may be the only indication needing attention. Moreover, it must be borne in mind that there are certain diseases in which the morbid condition of the mucous membrane is but a part of the general malady, and calls for no special treatment.

Frederick T. Roberts.

MUCOUS PATCH.—Synon.: Mucous Tubercle; Condyloma; Fr. *Plaque Muqueuse*; Ger. *Breite Feigwarze.*

When the term 'condyloma' is used, 'syphilitic' ought always to be prefixed, to avoid confusion with the simple form of growth. *See* Condyloma.

Definition.—A patch of syphilitic eruption upon mucous membrane or moist skin.

Ætiology.—Mucous patches belong to what are commonly known as the secondary manifestations of syphilis; they may appear early or late, both in the acquired and in the inherited disease, and are very liable to return time after time.

Experimental inoculation of the discharge of mucous patches has proved that it is capable of producing a hard sore at the point of insertion, followed by general symptoms; and clinical observation shows that these lesions are the most frequent means of spreading syphilis.

Description.—Mucous patches on the skin appear as flattened elevations of a round or oval shape, with a broad base, of a reddish colour, and generally covered by a thin grey pellicle. When in close proximity they coalesce, and form a mass of irregular shape and size, which may be fissured and ulcerated. When situated upon a mucous membrane they are usually less raised, and whitish in colour, especially in the throat, where they have been termed *plaques opalines*. The primary sore may assume the appearance of a mucous patch. The growths also sometimes become warty on the surface.

Favourite seats of mucous patches are the genital organs, and the moist skin about the anus. They may also be found at the umbilicus, in the axillæ, auditory meatus, or nose, on the nipples, and between the toes; in stout and dirty persons they may be met with wherever folds of skin meet and perspiration collects. They are very common about the lips, mouth, tongue, and throat; and occasionally are seen on the cervix uteri. Want of cleanliness favours their development, as does irritation from any cause, especially smoking and chewing tobacco.

Treatment.—Mucous patches, being highly contagious, should always be got rid of as soon as possible. In the mouth or throat, carbolic acid, or a solution of chromic acid (twenty grains to the ounce), may be applied from time to time, and an astringent mouth-wash used several times a day. Mucous patches on external parts usually disappear quickly under strict cleanliness and the application of calomel (one part) and oxide of zinc (three parts), care being taken to keep opposed surfaces apart with lint or wool. If the growths persist, carbolic acid or nitrate of silver or even the acid nitrate of mercury should be applied. General treatment must of course be carried out at the same time. *See* Syphilis.

George G. Gascoyen. Arthur Cooper.

MUCOUS RÂLE.—An adventitious sound heard on auscultating the chest in certain forms of disease, and due to the passage of air through viscid fluid in the bronchi. *See* Physical Examination.

MUCOUS SECRETION, Disorders of.—*See* Mucous Membranes, Diseases of; and Secretions, Disorders of.

MUCOUS TUBERCLES.—*See* Mucous Patch.

MULTILOCULAR (*multi*, many; and *loculi*, small spaces).—A term applied to cysts and other forms of growths, and to pulmonary cavities, when they consist of many small spaces or loculi. *See* Cysts.

MULTIPLE NEURITIS.—A synonym for peripheral neuritis. *See* Neuritis, Multiple.

MUMPS.—Synon.: *Parotitis*; *Cynanche Parotidea*; Fr. *Oreillons*; Ger. *Mumps*.

Definition.—An acute, febrile, infectious disease; attended with swelling of the salivary glands—mostly of the parotids; and ending in resolution.

Ætiology.—This is an affection more commonly seen in young persons—boys, growing girls, and young men; but it may occur in adults of either sex who are much with those affected with the disease, and who have not had the complaint before. Mumps rarely attacks the same person twice. It may occur as an epidemic in large institutions, such as schools and barracks. It is conveyed from person to person by contagion—that is, by infecting particles produced in the course of the disease, and given off by the sick, possibly even before the glands are affected, certainly for two or three weeks afterwards. It has an incubation-period of from eight days to three weeks.

Some hygienic defects may favour the spread of mumps. Whether it prevails more at one season than another is uncertain.

Anatomical Characters. — Not many, probably no cases of idiopathic parotitis afford the pathologist an opportunity of making a *post-mortem* examination into the nature of the affection. But arguing from analogy, some maintain that here, as in the more frequently fatal symptomatic parotitis, the inflammation has its starting-point in the gland-tissue proper, or in a catarrh of its duct. Others again assert, and this has long been the prevalent opinion, that the interstitial and the connective tissues around the gland are the seat of the mischief. The affection is probably both parenchymatous and interstitial. But wherever the inflammation has its origin, certain it is that the interstitial and cellular tissues around the gland are the parts which give most evidence of the existence of the disease. They become hyperæmic, infiltrated with serous fluid, and consequently much swollen. And this œdematous state passes to structures beyond those pertaining directly to the parotid gland. Seldom does there appear to be any fibrinous exudation poured out; and still less frequently do the tissues exhibit any tendency

to break down and to suppurate. The swelling completely disappears about three days after the fever. On the subsidence of the local lesion a so-called metastasis to the testicle and other glandular and fibrous structures is not rare. Alterations in the kidneys and atrophy of the testicles have followed; nor have the investments of the nerves, or the surfaces of the heart, always escaped.

Symptoms and Diagnosis.—Some general symptoms always precede the local manifestations of mumps; they may be so slight as almost to escape notice; or fatigue by day, restlessness at night, chilliness or vomiting may mark the prodromal stage. These initial symptoms do not occur until a week after exposure to infection, and may not be followed at once by the local signs. Mostly, after a week of malaise, or only a look of illness, the onset of mumps is sudden, with chill, rarely rigor, sometimes vomiting, and well-marked fever, often only a few hours before pain and swelling begin in the parotid or submaxillary glands.

One restless night follows, either from pain, or from fever, or both. Sometimes the pain is severe, and the temperature only elevated by one degree; sometimes the fever is more evident. It generally reaches 100° F. or 101°, and frequently rises to 103° or 104°; at this point it is not long maintained, but subsides as the local lesion is established, falling to the normal, or even below it, on the third or fourth day of the disease. The temperature may be low while the swelling is still marked and painful; and in some cases appetite returns before eating is easy. This happens when the patient is kept at rest in bed. Without such precaution, sudden and great elevations of temperature may occur at the end of the first week, either without serious local mischief, or with orchitis, deafness, tinnitus of one ear, and albuminuria, not always transient; rheumatism, and heart-affections, leaving traces both of pericardial and of endocardial inflammation, may also occur.

From face-ache and enlarged lymphatic glands, the sudden sensation of pain or stiffness in the parotid or submaxillary gland, following on the general symptoms, and absence of any such local trouble as usually affects the lymphatics, together with the history of a possible infection, will generally suffice for the diagnosis of mumps. Further evidence is obtained on examining the spot, where, besides the deeply seated swelling, considerable tumefaction of the parts surrounding the gland exists near the lobe of the ear, which very soon thereafter increases to such an extent as to involve more or less the whole of one side of the face, and passes down on to the neck. Coincidently with the appearance of this enlargement, the pyrexia declines in some cases; while in others some days elapse before the subsidence of the fever. Pain is now complained of, and the patient can no longer open his mouth to the usual extent. Yawning excites severe pain; in fact, it can hardly be effected. The yawn is aborted. So with mastication and speaking—they are greatly impaired, and the sufferer prefers to fast, and to remain silent, rather than endure the pain involved in the effort to perform either act. The saliva is either largely increased, going the length of salivation, or much diminished in quantity. If pressure be made over the swelling, the patient quickly indicates the unpleasantness and the pain of the proceeding; and the sensation afforded by manipulation is that of an elastic tumour, with a slightly softer feeling in the centre. The skin over the swelling may be slightly reddened; often there is no deviation from the normal colour, the skin remaining pale, but glossy, and œdematous. In many cases these symptoms are not nearly so severe, and the disproportion between the amount of distortion of the countenance and the actual suffering is sufficiently astonishing, as well to the patient as to the sympathising friends. Most frequently the affection is limited to one side of the face; but as the swelling of the one side subsides, the other may take it up, when it runs through the same series of events, with, possibly, an interval of a few days between them. Rarely are the two sides simultaneously affected; but in such a case the uneasiness, pain, and discomfort are of course greatly increased. After the continuance of these symptoms for about six or eight days, they begin to abate, the œdema lessens, the pain is lost, the stiffness and tension disappear, and in a few days the face acquires its usual appearance. A mild uncomplicated case endures about a fortnight. Occasionally there is left, for some time after this, a certain degree of hardness in the neighbourhood of the parotid, which gives no uneasiness, and can rarely be mistaken for tumour. In like manner, the history of the case will disclose the nature of other local pains, or of orchitis.

Not uncommonly, especially in young subjects, a 'metastasis' takes place from the parotid gland to the testicle in boys, and to the mamma or ovary in girls. When this occurs, and it may happen at any period of the disease, an exacerbation of the fever takes place, and at the same time pain in the inguinal region is complained of. An examination of the parts reveals the fact that there is swelling of the testicle, an orchitis, as well as an accompanying œdema of the scrotum. Rarely is the orchitis bilateral. In the case of the girl the vulva becomes the seat of œdema, and on pressure over the region of the ovary pain is elicited. The 'metastasis' may take place before the inflammation of the parotid has entirely subsided; and when

the orchitis abates, the parotid may again take on the inflammatory condition. Inflammation of the coverings of the brain is to be feared on sudden subsidence of the inflammation of the parotid, if no orchitis follow the disappearance of the original affection. Delirium, amblyopia, conjunctivitis, albuminuria, or gastro-intestinal disturbances are occasional complications.

PROGNOSIS.—This is almost invariably favourable in mumps, unless in the very weakly and in the tuberculous, or in the rare event of meningitis being developed. It may be said to be always a disease of a comparatively trivial nature, producing considerable pain and much discomfort, but not endangering the life of the sufferer. In very exceptional instances the inflammation of the parotid terminates in abscess. The indications of such an untoward result are increased pain in the centre of the swelling, hardness, and dark red appearance of the skin over the spot. In time the abscess discharges outwardly, or into the external auditory meatus. Atrophy of the testis sometimes follows 'metastatic' orchitis.

TREATMENT.—It may not, in every case, and at all seasons, be necessary to confine a patient suffering from mumps to his bed. But little treatment, beyond rest and care for the week or ten days this disease lasts, is required; still it is more prudent for the first few days to enjoin rest in bed. This is particularly necessary if the patient be young. In every case going out into the open air should be forbidden, and the patient recommended to keep as much as possible to one room. Rise of temperature means increased waste, and this is cancelled by rest. The bowels may require relief, as constipation keeps up disturbance of the temperature. All active evacuants should be avoided. It may be well to give some simple saline, as bicarbonate of potassium with lemon juice, and diluents during the first few days; ice is always grateful. A dose of chloral may be required at night (in children a grain for each year of the patient's age) if there be any restlessness.

As to local treatment, not much is required, unless the pain be unusually severe. It will be sufficient in most cases to protect the part from the air by means of a light handkerchief. Should more active interference be called for, some anodyne may be used, or soothing embrocation, such as the opium liniment, belladonna liniment, or external warmth; discretion in the use of these may safely enough be left in the hands of the patient himself, if of mature years. If there be the slightest tendency to suppuration, indicated by increase of fever and tenderness over the gland, with redness of the overlying skin, poultices must be had recourse to, and so soon as distinct fluctuation is discovered the abscess must be opened, otherwise the gland-tissue becomes still further disorganised, the lobules become softened and break down, and the gland is permanently destroyed. The application of leeches is useless in reducing the inflammation, or in staying the formation of the abscess. They may be of service in lessening the pain of metastatic orchitis or ovaritis; but these are well treated by the same gentle means employed in the case of the parotid itself. It is almost universally recommended in the case of a metastasis to try to induce a return of the inflammation to its original source, by the application of irritants to the parotid, such as a mustard poultice. This seems unnecessary in the majority of instances, as the inflammation is of such a mild type; besides, it implies a belief in the dictum that this is a true metastasis, and not merely another manifestation of the same morbid condition which originally gave rise to the parotitis. Tepid sponging is of use during the course of the disease, and a warm bath may be required when metastasis threatens. Sometimes wine or brandy is required.

Considerable anæmia and much debility may persist even when mumps has been mild in its course, especially in the weakly or unhealthy, so that tonics, with iron and cod-liver oil, may have to be continued for some time. C. MUIRHEAD.

MÜNSTER AM STEIN, near Kreuznach, in Rhenish Prussia.—Muriated saline waters. *See* MINERAL WATERS.

MURMUR.—This term, as used in auscultation, was originally applied to the natural sounds heard over the lungs in respiration; but its employment has since been extended to include a great variety of auscultatory sounds connected with the heart, the blood-vessels, the placenta, &c. *See* PHYSICAL EXAMINATION.

MUSCÆ VOLITANTES (*musca*, a fly; *volitans*, floating about).—*See* EYE, AND ITS APPENDAGES, Diseases of.

MUSCLES, Diseases of.—SYNON.: Fr. *Maladies des Muscles*; Ger. *Muskelkrankheiten.*

In describing the diseases of the muscular tissue attention will be confined to the voluntary muscles, excluding diseases of the muscular substance of the heart and other organs, which are treated of under their appropriate headings. Many of the morbid states of the voluntary muscles come properly under the consideration of the surgeon, and others are more suitably treated of in special articles on the various diseases of the nervous system with which they are associated. There still remain, however, certain diseases of muscles to be described here.

1. **Acute Inflammation.**—SYNON.: Myositis.—Ordinary inflammation of muscle,

leading to exudation and suppuration, arises chiefly as a result of injury, rupture of a muscle, or extension of inflammation from neighbouring diseased bones. Inflammation sometimes, however, arises spontaneously, particularly in the tongue, diaphragm, and psoas muscle; in the latter situation forming one variety of psoas abscess. The symptoms are pain, tenderness, and swelling, corresponding to the seat of the inflammation. Exudation of serum and of lymph takes place, and subsequently an abscess may form; occasionally the process goes on to gangrene.

Secondary inflammations and formations of pus are of more frequent occurrence than simple inflammation and abscess. They arise in the course of the various forms of pyæmia. The presence of such secondary abscesses in muscles is especially characteristic of glanders and farcy, where inflammatory infiltrations of various sizes appear in many of the muscles, especially those of the arm. Disintegration takes place in their centre, and a collection of puriform fluid results.

2. **Chronic Indurating Inflammation.**—In this form of inflammation there is proliferation of cells in the interstitial tissue, causing the muscle to become hard and painful. The whole muscle may be attacked, or the process may be limited to one or more portions. Infants are often attacked by chronic inflammation of the sterno-mastoid muscle. The whole muscle becomes hard and painful, but rarely suppurates. The disease usually yields to soothing external applications; but if it be of syphilitic origin, the use of internal antisyphilitic remedies may be required. In adults chronic indurative myositis of a syphilitic character may occur in the sterno-mastoid, the various muscles of the leg and arm, the temporal and masseter muscles, the tongue, and other parts. The disease may appear either as a diffuse inflammation, with the usual signs of pain on movement, tenderness, and some swelling—or sometimes a series of beaded swellings; or as a circumscribed inflammation, with an abundant infiltration of nucleated cells. If the inflammation does not soon subside, the cellular exudation becomes organised into contracting fibrous tissue, and the compressed muscular fibres atrophy. In diffuse myositis permanent contraction of the muscle may result from this cause; in circumscribed syphilitic myositis a fibrous tumour in the interior of the muscle may result; sometimes a gummy tumour is formed. Syphilitic tumours thus formed in the muscle bear a great resemblance to malignant tumours. Indeed, it is often found that the only means of distinguishing the two clinically is by the effect of iodide of potassium in causing the disappearance of the former.

3. **Rheumatic Inflammation.**—The morbid changes in this form of inflammation rarely pass beyond the stage of congestion and serous exudation, though occasionally proliferation of the interstitial tissue may occur, and callosities may be formed. *See* RHEUMATISM, MUSCULAR.

4. **Hæmorrhage.**—Hæmorrhage takes place in muscle not only from injury, but frequently in the course of typhus and typhoid fevers and pyæmia; also in leucocythæmia.

5. **Rupture.**—Rupture of muscle is a subject which falls more properly into the domain of the surgeon, but the accident occurs also in circumstances which may bring it under the notice of the physician. Violent contraction of a muscle, without external injury, may lead to partial rupture of its fibres—for example, the gastrocnemius. The violent spasms of tetanus occasionally cause complete rupture of a muscle, particularly of the muscles of the back, the rectus femoris, and the psoas. Rupture of muscles has been known to occur in the delirium of fever; and may be the cause of abscess forming in muscle, as described above.

TREATMENT.—The treatment of ruptured muscle consists mainly in rest; in the support of the muscle by uniform bandaging; and in suitable applications, should abscess form.

6. **Lesions of Sensibility.**—(*a*) *Myalgia.* This term was given by the late Dr. Inman to a painful condition of the muscles arising in those who are in feeble health. The pain is similar to that which is present in a muscle after long-continued and fatiguing exertion—for example, in the limbs after a long walk, or in the diaphragm and intercostals after violent laughing. In persons who are debilitated, pain may arise in the muscles after very slight exertion, and this constitutes myalgia. It is often accompanied by cramps at intervals. The pain is most commonly felt at the tendinous insertion of the muscle. The abdominal muscles are frequently the seat of myalgia, such as the costal origin of the external oblique—causing, according to some authorities, that pain in the side which is so common in women—and the pubic insertion of the recti. The muscles of the back, and especially the trapezius, also suffer; the muscles of the limbs much less frequently. When situated in the trunk, myalgia is often mistaken for some congestive or inflammatory condition of the liver, spleen, or other viscus lying beneath. The pains of myalgia are distinguished by their hot and burning character. They are increased by exercise of the affected muscle, and disappear when it is relaxed or artificially supported. However severe the pain may be, the pulse remains unaffected; but it is usually uniformly weak and fast.

The muscles or their fibrous connexions are also the seat of pain in the condition known as muscular rheumatism.

Treatment.—The muscles should have rest and support by bandaging. Tonic treatment is required. Dr. Inman especially recommended cod-liver oil and tincture of perchloride of iron. Friction and counter-irritation do little good. Exercise is of no use, unless combined with fresh air and good diet.

(*b*) *Muscular anæsthesia.*—This term is given by Dr. Russell Reynolds to a group of symptoms occasionally met with, and believed by him to be caused by loss of the 'muscular sense.' *See* Muscular Sense, Disorders of.

7. **Atrophy and Degenerations.**—(*a*) *Simple atrophy.*—Simple atrophy of the substance of muscular fibres arises either from general defective nutrition, during the course of wasting diseases, such as phthisis, in cachectic conditions, or after severe fevers; or as a local condition from disuse of the muscle. The muscles become pale and flabby. The ultimate fibres are reduced in volume, but preserve their anatomical characters, still showing the longitudinal and transverse striation. The atrophy is sometimes so advanced in parts, that the muscular substance of the fibre entirely disappears, and nothing is left but the sheath of the sarcolemma, which appears in the form of fibrous bands between the remaining muscular fibres.

As a local condition, atrophy is most frequently seen in muscles in the neighbourhood of a diseased joint, or in a paralysed limb. In these cases the atrophy is usually combined with more or less interstitial deposit of fat between the ultimate fibres, constituting *fatty growth* on or *infiltration* of muscle. Occasionally the amount of fat is so great as to cause an actual increase in bulk of the muscle, so that it appears hypertrophied. The atrophic and other changes arising in paralysed muscles are considered in their appropriate articles. Fatty infiltration of muscles may also arise as a primary condition, when there is an excess of fat in the blood, and atrophy of the muscular substance results from it.

(*b*) *Fatty degeneration.*—Here the fat is deposited, not between the ultimate fibres, as in fatty infiltration of muscle, but in their interior. Rows of minute granules appear in the longitudinal striæ, and gradually increase until the whole breadth of the fibre is occupied by them, and nothing is left but the sarcolemma. When the degeneration reaches this extent, it is of course irrecoverable. Muscles affected by this change become very soft and friable. This degeneration is met with much oftener in the heart than in voluntary muscles. It is sometimes associated with atrophy of the fibres in the muscles of limbs attacked by certain forms of paralysis. It is met with also in fever and phosphorus-poisoning, granular degeneration being the first stage. *See* Fatty Degeneration.

(*c*) *Granular degeneration.*—Granular degeneration of muscles occurs in fevers and acute diseases. The ultimate fibres become swollen and opaque, being filled with fine granules. These clear up on the addition of acetic acid; this test distinguishing granular from fatty degeneration. The muscles which are affected by it are soft and friable and easily rupture. The fibres no doubt ultimately recover their natural appearances; but if the disease be severe and long-continued, granular degeneration advances to fatty degeneration, as is seen in cases of phosphorus-poisoning.

(*d*) *Waxy degeneration*; *Vitreous degeneration*; *Myositis typhosa.*—This degeneration was first described by Zenker. The affected fibres swell and lose their striation; and become of a homogeneous, translucent aspect. After a time transverse fractures appear in each fibre, dividing it into a series of short cylinders. The nuclei of the sarcolemma also multiply. The change does not attack all the muscular fibres of a part uniformly; for healthy and degenerated fibres are seen side by side. It is observed chiefly in typhoid fever, cholera, and other acute febrile diseases, being often associated with the granular degeneration. It is usually found in the adductor muscles of the thigh, the abdominal and pectoral muscles, and the diaphragm; appearing in patches of one or more square inches, pale and glassy; gradually becoming softened and pulpy. It is now considered to be a condition of *coagulative necrosis* of the muscle.

(*e*) *Fibroid degeneration.*—Fibroid degeneration of muscle has already been referred to as a result of myositis. Chronic or repeated inflammation, of a rheumatic or syphilitic character, leads to the formation of fibrous tissue in muscle, and the muscle becomes of a tough, whitish character.

(*f*) *Ossification.*—Ossification of muscle is a rare result of chronic inflammation or irritation. It is observed to occur in muscles which are subject to pressure, as the deltoid in soldiers, and the adductors of the thighs in riders. In a few cases ossification of a considerable number of the muscles has taken place.

8. **Tumours.**—Besides the syphilitic, fibrous, and gummatous tumours already referred to, muscle is subject to growths of a sarcomatous and cancerous nature. Fatty, cartilaginous, vascular, and other tumours are also met with in this tissue, but rarely.

9. **Parasitic Affections.**—The chief disease of muscles belonging to this group is that due to the presence of *trichinæ* (*see* Entozoa). The *Cysticercus cellulosæ* is also sometimes found in muscles. *See also* Pelodera.

Alexander Davidson.

MUSCULAR ATROPHY, PROGRESSIVE.—*See* Progressive Muscular Atrophy.

MUSCULAR DYSTROPHY, PROGRESSIVE.—*See* Progressive Muscular Dystrophy.

MUSCULAR HYPERTROPHY.—An increase in muscular tissue, affecting either the voluntary muscles, or the muscular tissue of special organs, such as the heart, the intestine, or the bladder. True muscular hypertrophy must not be confounded with an increase in the volume of muscular structures from hyperplasia of the connective-tissue elements. *See* Hypertrophy; and Progressive Muscular Dystrophy.

MUSCULAR RHEUMATISM.—A form of rheumatism affecting the muscles. *See* Rheumatism, Muscular.

MUSCULAR SENSE, Disorders of. By the term 'muscular sense' is meant the sensation by which we are aware of the degree of force exerted by contracting muscles. By it we become conscious of the resistance to contraction, that is, the tension of the fibres, rather than of the contraction itself. This sense must be distinguished from the 'common sensibility' which muscles possess, and by which we feel—(1) pain on firm pressure; and (2) pain on tetanic contraction, whether spontaneous ('cramp'), or excited by faradisation, independently of the excitation of cutaneous nerves, as when the skin is insensitive. It must also be distinguished from (3) the sense of muscular fatigue. The muscular sense proper has been referred to a sensation in the joints, skin, and other parts, or of the position of the limb, but it may be unimpaired when this latter sensation is lost (*see* Kinæsthesis). But the term is often applied to the sense of posture. Probably this, and the discrimination of weights, are merely varieties of the manifestation of this sense. It has been thought to be merely the consciousness of the degree of the outgoing motor-impulse, but it may be lost when motor-power is normal, as in some cases under the observation of the writer, in which the muscular sense was suddenly lost in one arm, although the power was unimpaired. A poker did not seem heavier than a feather. The sensibility probably depends upon afferent fibres, which have been found by Tschirjew to terminate between the fibrillæ. They seem to be stimulated both by lateral pressure and longitudinal extension. They apparently course with the motor fibres in the mixed nerves, but pass to the spinal cord in the posterior roots. From the fact that the common and special sensibility of muscles may be lost in different degrees, it has been conjectured that in the cord the paths are not quite the same. The impulses thus generated may act first on the spinal cord, then on the cerebellum, and thence on the motor cortex.

Hyperæsthesia.—Increase of the common sensibility of muscles is not unusual (*e.g.* after cramp), but very little is known of that of the muscular sense. The sensation of restlessness, impelling movement, has been attributed to it, but without sufficient reason.

Anæsthesia.—Diminution of common sensation in muscles is frequent, with or without loss of voluntary power. Diminution of the special sensibility, *muscular anæsthesia*, or *muscular analgesia*, is occasionally observed, commonly in consequence of central disease, especially of the spinal cord, and is usually associated with a diminution of other forms of sensibility. Loss of muscular sense, however, may be present when cutaneous sensibility is unimpaired. The diseases in which muscular anæsthesia is commonly observed are locomotor ataxy and hysteria. In the former it is probably the cause of the ataxy; it bears no necessary relation to the change in cutaneous sensibility.

Symptoms.—In muscular anæsthesia the patient is unaware of the degree of force exerted by the contracting muscles, and is dependent for his knowledge of the position of his limb, and of its movements, mainly upon cutaneous impressions. Ignorance of the degree of contraction interferes with muscular coördination, by rendering this dependent on cutaneous and ocular perceptions. When these are perfect, the amount of incoördination may be slight. The condition of the muscular sense is ascertained by observing the accuracy of movement with and without closure of the eyes, and especially by ascertaining the sensitiveness to movement against resistance so applied as to affect the cutaneous nerves as little as possible. The best method for this purpose is to suspend a weight, in a bag or cloth, to the limb, and observe (*a*) the minimum which can be recognised; and (*b*) the least increase in a greater weight which can be distinctly perceived. The sensibility of the two limbs may be conveniently compared. In each of these points the muscular sense may present a deviation from the normal, and the change in the two is not always proportioned. The minimum recognisable, and the minimum difference recognisable, vary in different parts. The latter amounts in the case of the arm in health to a difference of $\frac{1}{40}$th in a weight of three or four pounds. Balls of similar size and appearance, but of different weights, have been employed for the same purpose.

Treatment.—Muscular anæsthesia usually occurs as part of a wider affection, as in hysteria and ataxy, and rarely requires special treatment. Sudden local loss of muscular sense commonly depends on an acute, localised change in the cord, and requires rest and counter-irritation. A case under the writer's care, involving the arm, was rapidly benefited by this treatment. Faradisation of the muscles may be useful in some cases.

W. R. Gowers.

MUSCULAR SPASM.—*See* Spasm.

MUSCULAR TIC.—A synonym for facial spasm. *See* Facial Spasm.

MUSCULAR TREMORS.—*See* Tremor.

MUSHROOMS, Poisoning by.—Synon.: Fr. *Empoisonnement par les Champignons*; Ger. *Pilzvergiftung*.

Poisoning by mushrooms is a not very common occurrence. Great discrepancy of opinion has existed as to the poisonous or harmless nature of some species of fungi. We are now, however, increasing our hitherto limited knowledge of the various species and varieties of mushrooms; and the comparatively recent researches of Schmiedeberg, Koppe, and others, have thrown great light upon the active principle of at least one mushroom—the fly-fungus. The varied toxic symptoms produced by the ingestion of mushrooms become more easily explicable when we bear in mind that only a few fungi are apparently poisonous under all conditions. They are *Amanita muscaria*, the fly-fungus, which grows not very plentifully in this country; *Russula integra* seu *emetica* (*Agaricus integer* seu *emeticus*), also not very common; *Boletus luridus* (*B. perniciosus*, *B. bovinus*); and *Amanita phalloides* (*A. bulbosa*, *A. venenosa*, *A. viridis*), to which belong the varieties termed *Agaricus citrinus* and *Agaricus virescens.* Other fungi are poisonous only under special conditions, among which may be named idiosyncrasy, and the susceptibility of young children to the toxic effects of mushrooms. The delicious edible morel even has been known to produce fatal results. It must not be forgotten that gastro-intestinal catarrh of a severe character may result from the ingestion of a large quantity of ill-cooked indigestible fungus-tissue; that the highly nitrogenous tissue of fungi is peculiarly prone to rapid decomposition; and that fungi as a class absorb excretory animal matters, perhaps unchanged. These circumstances may serve to explain some of the apparent anomalies connected with mushroom-poisoning. Some kinds of poisonous mushrooms have their active principle either dissipated or destroyed by the prolonged heat employed in thorough cooking.

Anatomical Characters.—Evidence of gastro-intestinal catarrh, more prominent in the stomach than in the intestines; signs of cardiac paralysis, or of asphyxia; occasionally fatty degeneration of the liver and other viscera; and minute sub-serous extravasations of blood, have all been noted after death from mushroom-poisoning.

Symptoms.—The symptoms of mushroom-poisoning are of a twofold character: gastro-intestinal irritation, and a so-called narcosis. After a meal of poisonous mushrooms has been taken, colic sets in, followed by nausea and repeated vomiting; and diarrhœa eventually supervenes. The onset of symptoms does not as a rule manifest itself till after the lapse of some hours, six or eight or more, from partaking of the fungi. But this period is liable to great variation, and may be much shorter. Fragments of the fungi may be recognised in the fæces; and, indeed, were it not for this, and the history of the case, a diagnosis from violent ordinary gastro-intestinal catarrh would often be impossible. In severe and fatal cases the stools of the patient may become rice-watery in character; the patient becomes algid, collapsed, and cyanosed, with muscular contractions; and in children convulsions are not rarely met with. The sufferer eventually becomes somnolent, and falls into a state of sopor; but this is perhaps not due to a true narcosis, but to the drain of fluid from the system, and carbonic acid poisoning.

When the *Amanita muscaria* has been taken, cerebral symptoms are more prominent. The patient appears to be in a state of inebriation; and there frequently appears to be a tendency to dash the head against a wall or other solid object. These symptoms are, however, not exclusively met with in muscarine poisoning, but may be observed when other fungi have been eaten.

Diagnosis.—The history of the case, and the detection of particles of the fungi in the fæces, are usually sufficient; but in the absence of these a diagnosis from natural disease is perhaps impossible. It has been proposed to test for the presence of muscarine, the active alkaloid of the fly-fungus, by applying a drop of the concentrated or unconcentrated urine to the heart of a frog. Muscarine causes the heart of the animal to stop in the state of diastole.

Prognosis.—The patient cannot be considered safe for at least three days, unless the more prominent symptoms have been markedly alleviated. Death may occur at any period between six and seventy-two hours. Recovery is frequent.

Treatment.—In poisoning by mushrooms emetics should be promptly administered, to evacuate the stomach, and those which are not of a depressing nature should be selected. The stomach-pump is perhaps of little service, seeing how persistently the particles of fungi adhere to the walls of the gastro-intestinal canal. Oleaginous purgatives, as, for example, a spoonful of castor oil in olive oil, may be advantageously administered. Fortunately the action of *muscarine*, which Schmiedeberg and Koppe have isolated as the active alkaloid of *Amanita muscaria*, and which is probably identical with *bulbosine*, stated by Letellier and Speneux to be the active principle of *Amanita phalloides*, is pretty well known. *Amanitine*, an alkaloid, is said to be an active principle in certain fungi, and is perhaps closely allied

to muscarine. Atropine appears to be a direct antidote to muscarine; and digitalis appears to be so in a lesser degree. Atropine should therefore be given in small doses in cases of poisoning by *Amanita muscaria*; and failing this some preparation of digitalis. Should atropine be administered, it would be well to avoid the use of opium; but if atropine be not administered, the exhaustive diarrhœa may have to be combated by the use of opiates combined with astringents.

THOMAS STEVENSON.

MUSKAU, in Silesia, in Germany. Sulphate of iron waters.

MYALGIA (μῦς, a muscle; and ἄλγος, pain).—A name for pain in a muscle. *See* MUSCLES, Diseases of; and RHEUMATISM, MUSCULAR.

MYCETOMA (μύκης, a mushroom).—A synonym for fungus-foot of India. *See* FUNGUS-DISEASE OF INDIA; and ACTINOMYCOSIS.

MYCOSIS FUNGOIDES (μύκης, a mushroom or fungus).—SYNON.: *Granuloma Fungoides* (Auspitz); *Fibroma Fungoides* (Tilbury Fox); *Lèpre Indigène* (Guérard); *Lymphadénie Cutanée* (Gillot); and probably *Eczema Hypertrophicum et Tuberculatum* (Erasmus Wilson).

The name here employed is that ultimately used by Alibert, who first described the disease in 1814 under the title of *Pian fungoïde*; and is descriptive of the tumours which are present in its later stages, irrespective of all theories as to their pathology.

DEFINITION.—A chronic disease of the skin, characterised by a more or less prolonged eczematoid condition, followed by the development of multiple fungating tumours; and almost invariably terminating fatally.

The affection is undoubtedly less rare than is usually supposed; at least six cases have been shown in recent years at the Dermatological Society of London, two of which were under the observation of the writer.

ÆTIOLOGY.—Of the ætiology of mycosis fungoides little that is definite is known. It attacks men with much greater frequency than women, and usually in middle adult life—from forty to fifty years of age; but one case is reported to have begun at the age of five (Port). It is certainly neither hereditary nor contagious.

SYMPTOMS AND COURSE.—The *first* manifestations of mycosis fungoides may resemble an erythema, an urticaria, or the earlier stages of an eczema. They usually consist of well-defined macules, or more extensive erythematous patches, of a pinkish or bright red colour which does not completely disappear on pressure. These may remain discrete, or may coalesce so as to cover large areas of skin, and show a marked predilection for development upon the trunk, scalp, and face, while the upper extremities are more frequently and more severely affected than the lower. The lesions are in the majority of cases notably asymmetrical. Erysipelatous outbreaks, with some elevation of temperature, are prone to occur from time to time, and are usually followed by temporary amelioration of all the symptoms. The patches, which are at first on a level with the surrounding skin, soon become elevated, infiltrated, dense to the touch, and covered with some fine desquamation. They are accompanied by a variable, but generally considerable, amount of burning, tingling, or itching, the latter symptom being in exceptional cases excruciating; papules and vesicles may form upon the patches either spontaneously or as the result of scratching or rubbing. It is almost pathognomonic of the disease that all these manifestations appear and disappear spontaneously with remarkable rapidity, leaving previously affected skin apparently healthy, or at most only slightly atrophic, scaly, or pigmented.

Although partial recovery may thus be said to occur, and complete recovery sometimes seems imminent, the disease invariably progresses to its *second stage*, which is characterised by the deeper infiltration of the derma, and the gradually increasing prominence of the patches, to constitute the *plaques lichénoïdes* of Bazin. They are irregular in outline, sharply demarcated, bossy on the surface, of a deep purplish or brownish-red colour, and may either be covered with thick scales like a psoriasis, or may ooze and scab like an eczema. These lesions present the same peculiarity as to rapid disappearance as those of the first stage. Another phenomenon noted in a few of the recorded cases—which constituted a marked feature in the two cases observed by the writer—consists in the frequent appearance of deeply seated lumps indistinguishable from boils, most of which disappear without treatment; some, however, rupture and discharge their pus, but never a necrotic 'core' comparable to that of a true boil. They may, or may not, leave disfiguring scars. When the scalp is involved the hair usually falls rapidly. The nails often become yellow, brittle, and deformed.

After a variable period of time the *third stage* of the disease is attained. It is characterised by the development of peculiar, generally multiple tumours upon skin which is either erythematous or infiltrated; occasionally, however, they spring up from apparently healthy skin. The tumours vary greatly in size, those on the hands being often not bigger than a bean and 'let into' the skin, while on the trunk they may be the size of an orange, or even larger. When situated in considerable numbers upon the face they give a leonine expression very

similar to that seen in leprosy. The tumours are sessile, sharply defined, firm, generally of a peculiar deep red colour, but sometimes pale pink or yellowish; they are usually lobulated, and have not inaptly been likened to tomatoes; the epidermis over them is intact, but stretched, tense, and glistening. The amount of pain attending them is variable, but usually they are tender to manipulation. Occasionally tumours appear in the mouth or fauces. In some of the reported cases early and conspicuous involvement of lymphatic glands has been noted, as well as leucocythæmia and enlargement of the spleen, but these appear to the writer to be examples of a separate disorder—a form of lymphadenoma—which it is of importance to differentiate from mycosis fungoides. The same may be said of the form described by Vidal as *Mycosis à tumeurs d'emblée*, in which there is no eczematoid, pre-mycosic stage, but the growths, which are usually localised, constitute the first and only manifestation of the disease. Such cases are probably examples of a form of true sarcoma of the skin (Perrin, Hallopeau).

When once developed the tumours may remain unaltered for an indefinite period. More frequently, however, a large number of them spontaneously disappear, leaving the skin either hardened, shrunken, pigmented, and desquamating, or else apparently healthy. Fresh erythematous and eczematoid patches nevertheless make their appearance, and fresh tumours, either singly or in crops; in one case (Stelwagon) as many as six hundred were finally present. Of these a certain number ulcerate slowly, the epidermis over them being destroyed; and hideous fungating ulcers are thus formed, from which a thin, ichorous, intensely fœtid fluid is discharged. At this stage itching and smarting usually cease, and the tumours become painless. But now for the first time—and the point is one of the most curious and characteristic features of the affection—the general health begins to suffer. Although many of the deep ulcerations may cicatrise, a profound marasmus is gradually established, the patient being usually ultimately carried off by diarrhœa or pulmonary complications.

Duration.—The duration of mycosis fungoides varies from a few months to twenty years or more (Besnier); on the average it is from five to six years. In one of the cases observed by the writer, apparent complete recovery took place under treatment, and persisted for more than six months, when a relapse occurred, during which the patient, who was very alcoholic, contracted acute pneumonia, of which he died. It is noteworthy that growths in internal organs have only been observed three times (Duhring, Galliard, Pye-Smith), and in each instance the association appears to have been a coincidence, as the internal tumours did not present the characters of the external ones.

Anatomical Characters.—The morbid changes are strictly confined to the skin and subcutaneous tissue. In the earlier erythematous stages, microscopical examination reveals turgescence of the capillaries, with diapedesis of red corpuscles, and considerable round-cell infiltration in spots in the upper layers of the corium. Mitoses are present in great abundance (Philippson). The rete Malpighii and epidermis are normal. The tumours are entirely composed of lymphoid cells, closely resembling those of round-celled sarcoma at first sight; but on closer inspection they are found to be in the meshes of a fine embryonic connective-tissue stroma. The cells are round or oval, almost uniform in size and shape, being about as large as a white blood-corpuscle; their nuclei are large and often multiple. In the earlier stages, and at the margin of the tumours, the granulation-cells are most abundant round the capillaries, the line of demarcation between healthy and diseased tissue being very ill-defined. In the centre of the tumours very few capillaries are present, and areas of cheesy degeneration exist here and there.

Pathology.—Divergent views are held as to the pathological group to which the tumours in mycosis fungoides belong. It will suffice here to state that Cornil and Ranvier regard them as *lymphadenomata*, and are followed by many of the French school; while Kaposi, Funk, and many German authorities, maintain that they are nothing else than *sarcomata*. Most recent observers, however, considering not only their microscopical characters, but also their clinical peculiarities, follow Auspitz in relegating them to the group of *infective granulomata*, the other members of which are tuberculosis, leprosy, rhinoscleroma, actinomycosis, glanders, and syphilis, all of which, except the last, would appear to have been shown to be due to the irritative presence of specific micro-organisms. Although many researches have been carried out by different investigators, only the most contradictory conclusions have hitherto been arrived at. Quite recently, however, Stelwagon and Hatch have demonstrated the existence in the tumours and in the capillaries surrounding them of micrococci averaging $\cdot 75\ \mu$ in diameter, of which pure cultures were obtained after repeated inoculations on the usual cultivating media. These micrococci did not liquefy gelatine, clearly showing that they are not pyogenic staphylococci, which they resemble in their morphology; but all attempts to reproduce the disease by inoculation in animals proved unsuccessful.

Diagnosis.—In the later stages of mycosis fungoides no difficulty presents itself as regards diagnosis; but in the earliest stage it may be impossible to differentiate the disease

from urticaria, erythema multiforme, or even pityriasis rubra. Its persistence and ulterior developments soon, however, settle the point. In the eczematoid phase the localisation of the patches, their asymmetry, the amount of infiltration and sharp delimitation, the scantiness of discharge, and their spontaneous appearance and disappearance, generally serve to distinguish the condition from any recognised type of eczema. The absence of anæsthesia, of leucoderma, of bullæ and atrophic nerve-changes, the characters of the mycosic tumours, and the history, enable one to distinguish mycosis fungoides from tubercular leprosy.

Frambœsia may, apparently, resemble it closely, but is a disease of tropical climates only, the tumours are always small, and there is no pre-mycosic eczematoid stage. The main points of difference from sarcoma and various forms of lymphadenoma of the skin have been already briefly alluded to.

Prognosis.—The prognosis of this disease is necessarily gloomy, but its rate of progress varies widely in different cases. It is only when the final ulcerative and cachectic phase is reached that the patient's condition becomes a very painful or utterly hopeless one.

Treatment.—One case of complete and permanent recovery is reported (Bazin) after an accidental attack of erysipelas; inoculation with the streptococci of that disease, in a manner similar to that successfully carried out in the treatment of intractable cases of lupus, carcinoma, and sarcoma (Fehleisen), appears, therefore, to be a rational and legitimate procedure.

Arsenic internally, in full and steadily increased doses, has yielded in many cases decidedly beneficial results in the early stages of mycosis fungoides—an observation which the writer is in a position to confirm from practical experience. Its administration hypodermically is probably advantageous, but is seldom tolerated. Mercurials and iodides appear to be deleterious rather than beneficial.

Externally, ointments containing pyrogallol (10 to 15 per cent.) seem particularly efficacious in the eczematoid stage. When tumours are present, the injection of strong carbolic acid into their base has been suggested by Dr. Radcliffe Crocker. If ulceration of the tumours has set in, the most scrupulous cleanliness and careful nursing are required. The horrible fœtor is best controlled by dusting with salol (one part to ten of subnitrate of bismuth), and covering with antiseptic gauze and absorbent wool. Washing with camphorated naphthol has been recommended by Brocq, and lotions of creolin or any other antiseptic are probably useful. Surgical ablation of the tumours has been carried out with success, and without local recurrence, in a few cases in which their number was limited.

J. J. Pringle.

MYDRIASIS (μυδρίασις).—This word was used by Galen and other writers to signify an undue enlargement of the pupil; but by Aretæus (περὶ χρονίων παθῶν, I. 7) to mean a shrinking or contraction of the pupil. Aretæus employs the word πλατυκορία (ibid.) to express dilatation of the pupil. The word is now invariably used to mean a preternatural dilatation, and sluggishness or immobility of the pupil. It is the opposite of myosis. *See* Pupil, Disorders of.

MYELITIS (μυελός, the marrow).—Inflammation of the spinal cord. A term that has been much abused, and which is still often wrongly applied to many mere degenerative softenings of this organ. *See* Spinal Cord, Diseases of.

MYELOID
MYELOMA } (μυελός, the marrow).—A form of sarcoma, characterised by the presence of giant or myeloid cells. *See* Tumours.

MYOCARDITIS (μῦς, a muscle; and καρδία, the heart).—Inflammation of the walls of the heart. *See* Heart, Inflammation of.

MYOCLONUS MULTIPLEX.—*See* Paramyoclonus Multiplex.

MYOPIA (μύωψ; from μύω, I close or blink; and ὤψ, the eye).—That form of *ametropia*, or error of refraction, in which, owing to a high refractive index of the dioptric media, or excessive convexity of the refracting surfaces, or abnormal elongation of the antero-posterior axis of the eyeball, parallel rays of light converge to a focus in front of the retina, and form therefore circles of diffusion upon the retina. It is the opposite of hypermetropia (*see* Hypermetropia), and is sometimes called *brachymetropia* (βραχύς, short; μέτρον, a measure; and ὤψ, the eye), or *hypometropia* (ὑπόμετρος, below the measure). *See* Vision, Disorders of.

MYOSIS (μύω, I shut).—A preternatural contraction and sluggishness or immobility of the pupil. The opposite of mydriasis. *See* Pupil, Disorders of.

MYOSITIS (μῦς, a muscle).—Inflammation of a muscle. *See* Muscles, Diseases of.

MYOTATIC (μῦς, a muscle; and τατικός, extended, tense).—Tense-muscle irritability or action. 'Myotatic irritability' and 'myotatic action' are terms introduced by Dr. Gowers, and occasionally employed as designations for the phenomena termed 'tendon-reflex,' or the conditions under which they occur. The term 'myotatic' was proposed as involving no theory of the nature of these phenomena, but merely the unquestionable fact that they can only be elicited when the muscles are in a state of moderate extension, usually passive. *See* Spinal Cord, Diseases of.

MYXŒDEMA (μύξα, mucus; and οἴδημα, a swelling).

DEFINITION.—Myxœdema is a name given by the writer to a progressive disease, in which the tissues of the body are invaded by jelly-like mucus-yielding dropsy, unaccompanied by albuminuria or other signs of primary affection of the kidneys. The condition gives rise to remarkable changes in physiognomy, and is associated with many signs of nervous disorder.

ÆTIOLOGY.—The original article on myxœdema in this *Dictionary* was founded on sixteen cases. Since then more than 100 cases have been recorded, and have been analysed by a Committee of the Clinical Society of London. From the report of this Committee it appears that the direct cause of myxœdema is the destruction, or loss of the function, of the thyroid gland. In the cases reported the disease affected men as well as women, in the proportion of fifteen to ninety-four (about one to six). Myxœdema appears to be identical with *cachexia strumipriva* (Kocher) and *sporadic cretinism* (Curling). The ultimate cause of the obsolescence of the thyroid gland does not at present appear; but it is in a certain proportion of cases preceded by enlargement of the gland. The disease is, in a small degree, hereditary.

ANATOMICAL CHARACTERS.—The first, and, as at present believed, the most important, is the change in the structure of the thyroid gland. This change appears to be of one kind in the very large majority of cases. An early stage of small-celled infiltration of the walls of the vesicles is followed by epithelial proliferation in the vesicles themselves. Later on, the gland becomes converted into a delicate fibrous tissue in which clumps of small round cells, clearly the remains of the vesicles, are scattered. And, still later, the gland-structure is almost entirely replaced by fibrous tissue, the organ itself being greatly reduced in size. The changes in the skin and tissues which bring about the striking physiognomy of the disease are probably secondary to the affection of the thyroid. A remarkable overgrowth, consisting in part of hyperplasia, in part of retrograde degeneration of connective tissue, is found in several or all parts of the body. The fibrillar constituent of ordinary connective tissue is everywhere increased, and its elements unnaturally defined; the corpuscles are enlarged and multiplied; the interstitial cement enormously augmented. In normal tissue this latter element yields some mucin. The skin in myxœdema yields, in some cases, many hundreds of times as much mucin as ordinary or anasarcous skin.

To such amplification and mucous infiltration the skin owes its swelling, its translucency, and its defect of secretion. The same sort of interstitial expansion is found in the mucous membranes, in glands of all kinds, in muscles, and in the central ganglia of the nervous system, subjecting the proper structural elements of each tissue to destructive pressure. It is most developed of all, perhaps, in the outer coat of arteries. The diminution of the thyroid is associated with an almost complete annihilation of the proper gland-structure by this stuff; and the late occurrence of albuminuria marks the advanced progress of its inroads on the Malpighian bodies and tubules. Whether the mental failure of the last stage be due to the operation of similar changes in the brain, is not a matter upon which a decision is at present possible. In some cases there appears to be a general increase of neuroglia, and a very considerable development of the connective tissue around all the vessels. It must be observed that the appearances and chemical changes just described are, as indeed might be expected, not uniform. They are present in the case of persons dying in the full development of the disease; but are less marked in a larger number where the characters of the disease have been altered by changes preceding death.

SYMPTOMS.—In myxœdema the physiognomy is the first characteristic. The face is swollen in every feature, so as to suggest the existence of renal disease. But while the negative results of a complete examination dispel this idea, the distribution and quality of the swelling are different from what is observed in common dropsy. The swollen skin is singularly waxy-looking and anæmic; and the swelling affects dependent and non-dependent features equally. Thus the upper and lower eyelids, and the upper and lower lips are uniformly enlarged; the alæ nasi are thickened and broadened; the ridges of expression are blurred and coarsened, or the lines obliterated. The œdema is resilient; does not pit on pressure; and shows, as the foregoing statement indicates, no tendency to shift by gravitation. The cheeks are overspread with a dull pink flush, abruptly limited towards the orbits, and standing in vivid contrast with the anæmic skin around.

The conditions observed in the face prevail throughout the body. The skin is everywhere thickened, translucent, dry, and rough to the touch; perspiration being infrequent or absent. The hairs begin early to fall out, and are ragged and broken. Similarly the teeth decay, or without decay become loosened and have to be removed, or fall out. The hands, in particular, lose all shapeliness and expression, and received from the late Sir William Gull the appropriate epithet, 'spade-like.' All visible and tangible mucous membrane is similarly amplified. Late in the disease ordinary anasarca is often added to the mucoid œdema. A noteworthy phenomenon is the occurrence of tumefaction, with marked resilience of the skin, in the lower triangle of the neck, above the clavicle. A similar tumefaction is met with also in sporadic cretinism.

An affection of the nervous system as well marked as that of the skin, belongs to myxœdema. In the earlier stages an ever-increasing hebetude involves sensation, voluntary movement, and intellect; in the later stages aberration of mind often supervenes. The face wears a fixed, heavy, and withal most sad expression; the speech is slow and laboured, though not slurred or slovenly; the voice monotonous, like that of an automaton, and leathery in tone. Sensation is slow, yet finally sure. The movements of the limbs are slow and languid; the maintenance of fixed attitudes requires much effort; and sudden falls are not infrequent. It appears as if the muscles were toneless and excessively relaxed during rest, so that a considerable initial contraction is necessary before they bear on their attachments; and as if the muscular sense were also torpid. The result is that while there is neither jerking nor tremor of the legs in walking, the balance of the body is painfully maintained, as the weight is thrown on each leg in succession; and a quiver often runs through the body at the moment of raising one foot from the ground and balancing the body on the other. This tardiness of coördination is altogether different from the vague staggerings and jerks of locomotor ataxy, and from the rhythmical tremors of disseminated sclerosis. It must be remembered that there is no real loss of muscular power, no wasting of muscles, and no loss of sensation. Laxity of muscles at rest gives rise to drooping of the head on the chest in some cases; in others it has led to fracture of the patella, by allowing, first, a yielding of the extensors of the leg, followed by a delayed and vigorous contraction to avert the impending fall.

In the operations of the intellect, thought and volition are again slow. All the patients observed have complained of being unable to perform any of the daily actions of life with their natural expedition. Yet whatever they actually do is well done, and they are acutely conscious of their shortcoming in activity. In conversation ideas come deliberately, and are tardily expressed. To write a letter occupies an hour where it would before have taken ten minutes. Yet the language is correct, and the caligraphy unchanged. There is, in fact, an unwieldy state of mind as of body. The difficulty of collecting thoughts gives an early impression of loss of memory. This, in fact, occurs late in the disease, when other aberrations are developed. In a few cases paroxysms of maniacal delirium have occurred, mostly in the advanced stage of the disease. But in one case such an attack came on as early as fourteen months after the first appearance of the general symptoms. This patient afterwards completely regained a sane state of mind. Signs of bulbar disease have been recorded in a small number of cases, ending in fatal result.

Two affections of the special senses apparently related with changes of the periphery are often noticed—one a persistent unpleasant taste, sometimes of bitterness, sometimes of sweetness, &c.; the other a persistent unpleasant smell. Otherwise the special senses show no defect save tardiness.

The heat of the body is almost always lower than normal, ranging between 98° and 94° F., or even less. Most patients complain of constant chilliness, without appearing to estimate at all readily changes of external temperature. The viscera give no signs of organic affection in the beginning of the disease. The urine is usually increased in quantity; lowered in specific gravity; and contains no albumen, sugar, or casts. The uterine functions go on as in health. As the affection advances various indications of damage to viscera are declared, and the urine is generally albuminous in the last stage. We may note here that a decided tendency to hæmorrhages has been found to prevail, and is not an unimportant character of the disease. The extraction of a tooth is often followed by prolonged irrepressible bleeding from the socket and gums. In further advance, together with all the indications of great general debility, the mind often becomes unhinged. Lethargic good temper is exchanged for moroseness, fretfulness, suspicion, irritability; delusions or hallucinations often follow; and there is a speedy lapse into coma. Death comes either by coma, or asphyxia, or with the signs of uræmic poisoning, or by inanition, unless by intercurrent disease.

Prognosis.—The progress of the disease appears to be far from uniform. The first cases observed, naturally very marked cases, went on steadily from bad to worse without fluctuations. But a wider observation shows that there may be many alterations in the symptoms, that the swelling of the skin and the nervous disorder may vary considerably from time to time, so that occasionally the disease may seem to disappear. But in the main the ultimate prognosis is not favourable. The disease has now been known to last in some cases as long as fifteen years, but even then life has been far shorter than the average.

Treatment.—In Mr. Horsley's valuable experimental investigations on the lower animals it was found that the appearance of the symptoms of myxœdema after the removal of the thyroid body was greatly delayed when the subjects were kept in a well-maintained warm temperature. Experiment with myxœdematous patients accords with this observation, and probably the most important part of treatment is to keep the patient carefully sheltered from the cold. In fact the writer's personal observations show that prolonged residence in warm climates will nearly

always remove much discomfort, and delay the progress of the disease. In some cases the effect has appeared to be actually curative. A second point in treatment consists in the endeavour to restore healthy action of the skin. Vapour baths and hot-air baths have sometimes been found very useful. The baths of Aix-les-Bains and Royat have also been of great help in early cases. In addition to the use of baths, jaborandi may with advantage be given regularly. The writer has records of more than a dozen cases in which the steady administration of jaborandi during several months has been followed by great benefit, sometimes even by the complete disappearance of the symptoms. The practice has been to give doses of from ten to sixty drops of the tincture of jaborandi in warm water three times a day. Frictions of the skin and massage are reported to have done great good in some cases. Quite recently a well-marked case has been reported to be completely cured by vigorous friction of the whole of the body with olive oil, frequently repeated over a period of more than a year. As regards drugs, iron and arsenic have their place in the treatment of the anæmia; iodide of potassium has been reported as very useful in some early cases.

Lastly, the possibility of effecting something like a radical cure of myxœdema has to be entertained. This, as performed by Boccher, consists in implanting in the tissues of the patient either a thyroid gland taken from one of the lower animals or a portion of a goitre. Improvement appears to have followed the operation, but not to have been permanent. Enough has been done to justify the hope that with improved methods of operation enduring benefit may be attained.

The preceding paragraph has since been abundantly justified. Dr. G. R. Murray of Newcastle-on-Tyne has conceived the idea of injecting hypodermically the juice of the fresh thyroid gland of the sheep in the form of a glycerin extract. It is obvious that such a method, wherein repetition of doses is practicable, offers a great improvement upon implantation. Dr. Murray's brilliant suggestion has been followed by remarkable results. In many cases the symptoms of myxœdema have entirely disappeared under the use of injections corresponding to one-half or one-third of the gland of a sheep administered twice or thrice a week. Later, Dr. Hector Mackenzie has used the raw thyroid gland of the sheep as a food in myxœdema. The results here are even more remarkable. It is probable that the symptoms of myxœdema will yield readily to the administration by the mouth of the fresh thyroid gland of the sheep, of the glycerin extract, of the ferment precipitated by a process devised by Mr. White of St. Thomas's Hospital, or of other active preparations of the gland. But it is important to note that the gland administered in these several ways is a drug of great power, and must be used with caution, in moderate doses and over long periods. It is evident that in respect of myxœdema we have an effective cure in our hands, not as yet fully worked out, but even now constituting a very remarkable instance of the advancement of medical science. It is evident also that a new method of therapeutics, the extension of which to other organs than the thyroid body offers great possibilities, is hereby added to the science and art of medicine.

William M. Ord.

N

NÆVUS.—*See* Tumours.

NAILS, Diseases of.—Synon.: Fr. *Maladies des Ongles*; Ger. *Krankheiten der Nägel.*

It has been usual to divide the morbid affections of the nails into two groups: A. *Diseases of the Nails proper*; B. *Diseases of the Soft Parts in immediate relation with the Nail.* This division, although it may be retained, is of no great practical value, because diseases of the nails mainly result from those of the soft tissues immediately connected with them.

Description.—Affections of the nail proper belong, for the most part, to those of defective nutrition, and resolve themselves into the various forms of hypertrophy, atrophy, and malformation. For example, we meet with the well-known lateral hypertrophy, where the borders curve inwards and press into the cutis, thus forming the painful 'ingrowing nail.' Again, we have a different form of hypertrophy, where the central part of the nail becomes thickened into an irregular shapeless mass, more or less covered with ridges or furrows, and altered in texture, so that it becomes opaque, brittle, and discoloured. Atrophy of the nail is less common than hypertrophy; it occurs, however, occasionally from injury, and also in connexion with certain diseases. Malformation of the nail is occasionally met with in ichthyosis. A congenital arrest of development of the nails is sometimes associated with a similar condition of the hair.

We may expect to meet with alterations in the growth of the nails from blows and

injuries, or from undue pressure; and also from various diseases which interfere with the nutrition of the nail, such as eczema and psoriasis, but especially in pityriasis rubra, leprosy, and syphilis. Whenever any of these chronic diseases attacks the nail-matrix an alteration in the growth of the nail occurs, and an irregular hypertrophy or atrophy of the nail is the result. In very acute inflammatory affections, such as erysipelas and acute onychia, a complete shedding of the nail may take place. In all those chronic diseases in which the nails are apt to be affected, the matrix and bed of the nail are usually the first to suffer, and hence we generally see the changes apparently originating in the lunula. Sometimes, however, the altered condition of the nail is first noticed at the margin or anterior border. In these cases it is probable that changes have been going on gradually, though unperceived, for a considerable time, and that they are not really confined to the edges, the whole nail being more or less altered in texture.

A. Diseases of the Nail proper.—1. *Colour.*—The nails, which are naturally translucent, may become brown or grey, of a dirty appearance, or opaque with small roundish white spots, which are due to the presence of air, as in the white scales of psoriasis; in rare instances the nail assumes a general opaque whiteness. These changes may occur without any apparent disease in the surrounding tissues, and are of themselves of no great importance.

2. *Texture.*—Alterations in the texture of the nail-substance are not very uncommon. Nails are sometimes too soft, and bend too easily under pressure; much more frequently they are too brittle, and crack and break from the slightest cause. Associated with this latter condition, the surface of the nail usually loses its smooth and polished appearance, and becomes rough and eroded as if superficially worm-eaten.

3. *Form and growth of the nail.*—Any considerable alteration in the form of the nail is generally associated either with injury, or with some severe disease of the skin. In some instances the alteration is so great that the nails become twisted into thick curved cylinders, and resemble horns rather than nails, presenting a claw-like appearance. A very different alteration in the form of the nail is sometimes met with in cyanosis and some other diseases, in which the top of the finger becomes enlarged, and the nail club-shaped. The growth of the nail is much influenced by the general state of health, and during a period of illness there may be a deficient formation of horny matter, which results in the production of a groove across the nail; the breadth of the groove will roughly indicate the period and duration of the illness.

4. *Development.*—Congenital malformation of the nails is rare. As already stated, there may be congenital absence of nails. There is also occasionally met with the bifid or double nail, which is associated with a broadening and a tendency to bifurcation of the distal phalanx.

5. *Parasitic affections of the nails.*—See Tinea.

B. Diseases of the Soft Parts in immediate relation with the Nail.—These may be divided into three principal groups: (1) Those forms of simple skin-diseases which are especially liable to attack the fingers, such as eczema, psoriasis, and pityriasis rubra; (2) the various forms of onychia, including those which result from particular occupations or from syphilis; and (3) paronychia.

1. All diseases of the skin which affect the tissues in immediate relationship to the nails are apt to alter the growth of the nail itself, and lead to those changes which have already been referred to; moreover, as these maladies are fully described elsewhere, it is scarcely necessary to do more than merely refer to them here.

2. *Onychia.*—Onychia is an inflammation of the matrix. It is met with of a somewhat severe but non-syphilitic type in manufacturing towns, and is said to be especially prevalent in the flax-spinning mills of Belfast. The best known form of the disease, however, is of syphilitic origin. It is met with in two common varieties. The first or *subacute* form is often seen in congenital syphilis, and is attended with pain, redness, and discharge of pus around the nail, and more or less ulceration of the matrix. (2) The second variety is met with *in adults*. The nail first becomes spotted and furrowed, then gets rotten and brittle and crumbles away at the root, so as to leave a ragged border attached to the distal portion; the free edge and margins of the nail also suffer, and become broken and fissured.

3. *Paronychia.*—Paronychia or whitlow is an acute inflammation of the tissues around the nail. It is attended with considerable pain.

Two forms are usually described, but they do not differ essentially the one from the other. Both are really traumatic, and depend on the inoculation of pus or some septic matter through a scratch or slight injury to the skin. As a consequence of this inoculation the distal phalanx becomes swollen and painful, and a bulla or pustule may form. Very frequently the inflammation of one finger is followed by that of others, probably also from inoculation.

In the more severe form of the disease, when septic matter has been introduced, the inflammation may spread up the finger, and affect the lymphatics and the lymphatic glands. In another form of whitlow the inflammation begins in the sheath of the flexor

tendon, but this variety belongs to the department of surgery.

Treatment.—As diseases of the nails are for the most part produced by various affections of the skin attacking the soft tissues in their immediate neighbourhood, the indication for treatment will, of course, be the cure of the primary disease. Although, the changes of the nail being slow, the defects will not pass away directly the disease giving rise to them has been cured, yet in course of time the nail will assume its normal appearance. In almost all acute inflammations water-dressings or poultices are suitable at an early stage; this may be followed up by soothing antiseptic lotions and ointments. In chronic inflammation round the edge of the nail, daily painting with a solution of nitrate of silver (gr. 10 ad fl. ℥j.) will be found one of the most useful kinds of treatment.

Where an ingrowing nail keeps up a paronychial inflammation, the body of the nail should be thinned by scraping, so as to diminish the pressure, and then a minute compress of cotton wool should be so passed beneath the adjoining part of the nail as to direct the ingrowing part upwards and outwards. The plan of scraping the nail thin is also useful when a splinter or some similar foreign body has run immediately behind the nail and broken off, and thus become embedded under it; in this case the nail should be scraped very thin immediately over the splinter, and then cut through. If this is done carefully, the foreign body may be removed almost without giving pain.

In subacute onychia, attended with ulceration, a dressing of powdered nitrate of lead has been strongly recommended. The treatment of syphilitic onychia is similar to that adopted for syphilitic inflammations in other parts of the body. *See* Syphilis.

In all the milder forms of whitlow the arm should be placed in a sling, and the finger constantly dressed with lint kept moist with some weak antiseptic lotion—a boric-acid lotion answers the purpose very well. When the inflammation has a little subsided, the finger may be dressed with boric-acid ointment. Tonics, especially cinchona bark or quinine, should be given internally. All the more severe forms of whitlow require surgical treatment. Robert Liveing.

NAPLES, in South Italy.—Changeable climate. Mean temperature, winter, 48° F. Cold winds in spring. *See* Climate, Treatment of Disease by.

NARCOSIS NARCOTISM (ναρκόω, I benumb).—A condition of profound insensibility, due to the introduction of certain poisons, or excessive doses of certain drugs, into the system, such as opium, chloroform, ether, or alcohol; or to the retention in the blood of certain effete alkaloidal and extractive elements which should have been excreted by the liver or kidneys, *e.g.* in uræmia, or of other morbid poisons. *See* Consciousness, Disorders of; Narcotics; and Uræmia.

NARCOTICS (ναρκόω, I benumb).—Synon.: Fr. *Narcotiques*; Ger. *Narkotische Mittel.*—Definition.—Remedies which promote or artificially imitate the natural physiological processes of sleep; but which in large quantity produce complete insensibility.

Enumeration.—A convenient division of narcotics, in the limited sense of hypnotics, may be made into (1) *indirect* narcotics, which include many soothing and hygienic conditions, anodynes, Conium, &c.; and (2) *direct* narcotics, of which Opium, Chloral Hydrate, Butyl Chloral Hydrate, the Bromides of Potassium, Ammonium and Sodium, Hyoscyamus, Stramonium, Belladonna, Hop, Indian Hemp, Alcohol, Digitalis, Sulphonal, Paraldehyde, Amylene Hydrate, Methylal, and the anæsthetic vapours are in most general use.

Action.—The *indirect* class of narcotics have no primary influence over the cerebral circulation, but act either by supplying warmth, quiet, and other tranquillising elements, or by removing some disturbing cause which renders sleep impossible. We know how powerfully sleep is under the influence of habit and regularity; how an excess of heat or cold, an inconveniently placed pillow, or a penetrating beam of morning light may often produce more or less restlessness; and the insomnia of feebleness or exhaustion may readily yield to a little nourishment, or to a well-timed dose of alcohol.

Pain is probably the most frequent cause of want of sleep; and if we can remove this, sleep usually follows. This we can do by removing the direct cause—extracting an aching tooth, opening an abscess, giving a dose of quinine, or checking the conductivity of sensory nerves by local anæsthetics or opium, by heat or cold, by electricity, or by forcible stretching of the nerve itself. Or we may interfere with the reception and registration of the painful impression at headquarters, by the use of some of the direct narcotics, which either produce some specific effect upon the cerebral grey matter, or have a decided action on the blood-supply of the brain, by constricting its vessels, and producing that degree of anæmia which more or less suspends its functions, and causes sleep. In larger doses, however, an opposite effect results, and we then see the cerebral congestion, the livid face, and the gradually deepening coma, which too surely indicate the fatal termination of opium-poisoning.

Uses.—Enough has been already said regarding the general principles on which we employ indirect narcotics; but the tact and ingenuity of the physician will often be severely taxed to discover the precise cause

on which the want of sleep depends. When remedies, however, of the more domestic class have been exhausted, we must have recourse to drugs, and a brief *résumé* may now be given of the advantages and disadvantages of those remedial agents the soporific qualities of which have been established by experiment and experience.

Opium and morphine naturally stand first, and still hold their place as our most potent and reliable narcotics, all the more valuable because, almost alone in their class, they are also endowed with powerful anodyne action, in virtue of which they may relieve pain without causing sleep. Valuable as it is in all forms of insomnia, opium is especially indicated in typhus fever and other acute disorders, when delirium and prolonged wakefulness seem to endanger life. The principal drawback to opium are the disturbances of digestion and of the secretions and excretions attending its use, and the fact that as toleration is rapidly established, increasing doses are needed to check the counteracting influence of habit.

Chloral hydrate is less to be recommended in acute diseases, on account of its tendency to cause cardiac failure, but it is of essential service in simple insomnia, in chronic affections where the prolonged use of narcotics is required, and in delirium tremens. In prescribing it we must not forget its weakening action on the heart, and on the respiratory centre, nor the petechial and other skin-eruptions which have been described as following its use.

Bromide of potassium is peculiarly well fitted to soothe the brain when rendered irritable by over-work, but we must remember that it is very uncertain as a narcotic, and is apt to produce eruptions and muscular weakness. *See* BROMISM.

Digitalis is of use when flaccid vessels permit a free flow of blood to the brain, thus effectually preventing sleep when the patient occupies the recumbent posture, the tonic influence of the drug enabling a due amount of cerebral anæmia to be obtained.

Conium may prove narcotic, by stilling the disorderly movements of chorea or of acute mania.

The other narcotics may be tried when the more potent remedies of the class fail or lose their power. Of those which have been more recently introduced, sulphonal seems the most worthy of confidence. Under certain circumstances a combination may succeed better than simplicity. Thus chloral hydrate and bromide of potassium are more valuable in acute mania when given together than alone; and opium and tartar-emetic are well known to form one of our most effectual means of dealing with some of those very intractable forms of sleeplessness which occur in the course of typhus.

ROBERT FARQUHARSON.

NATAL, in South Africa.—Warm, but healthy climate, with hot, wet summers, and dry, clear winters. High winds from S.E. and N.W. Soil, sandstone and granite. *See* CLIMATE, Treatment of Disease by.

NAUHEIM, in Germany.—Gaseous thermal salt waters. *See* MINERAL WATERS.

NAUSEA (ναῦς, a ship, in relation to sea-sickness).—A feeling of sickness or inclination to vomit, generally accompanied by a sense of disgust or loathing, and sometimes by a feeling of great depression. *See* SEA-SICKNESS; and VOMITING.

NAUSEANTS (ναῦς, a ship).—DEFINITION.—Agents which produce the feeling of nausea.

ENUMERATION.—The principal nauseants are Warm Water, Tartar Emetic, Ipecacuanha, Tobacco, Squill, and Apomorphine.

ACTION.—These substances produce irritation of the stomach, loss of appetite, general malaise, enfeebled circulation, muscular weakness, and frequently also salivation and sweating.

USES.—Nauseants have been employed to diminish appetite, in the hope of causing absorption of fatty accumulations, or of pathological deposits. They are also used in producing relaxation of involuntary muscular fibre, and thus accelerating the passage of calculi through the bile-duct or the ureters; and occasionally they have been employed to relax rigidity of the os uteri in labour. They were formerly used to produce relaxation of voluntary muscles, in order to facilitate the reduction of dislocations, or to subdue the paroxysms of delirium or mania. For such purposes, however, they are now replaced by anæsthetics or other sedative measures. They are still used to excite sweating. *See* DIAPHORETICS; and EMETICS.

T. LAUDER BRUNTON.

NEAR-SIGHTEDNESS.—*See* MYOPIA; and VISION, Disorders of.

NECROBIOSIS (νεκρός, a dead body; and βίος, life).—Molecular death of a tissue without loss of continuity, especially seen in the various forms of atrophy and degeneration. *See* ATROPHY; and DEGENERATION.

NECROPSY (νεκρός, a dead body; and ὄψις, a view).—SYNON.: Fr. *Nécropsie*; Ger. *Leichenschau*.

DEFINITION.—The inspection and examination of the body after death.

METHOD.—After making a complete inspection of the body externally, and noticing the general appearance, *rigor mortis*, change of colour—whether partial or general, œdema, marks of injury, and other points, a *post-mortem* examination should begin with the head, or, if the spinal cord is to be examined, with the spine.

Head.—To open the head, make an incision down to the bone, across the vertex from the base of one mastoid process to the other, and reflect the scalp backwards and forwards; then divide the bone all round with the saw, beginning in front a little above the level of the superciliary ridge. The posterior half of this section should make an angle with the anterior half by being brought over the occipital bone, a little behind the apex of the lambdoidal suture. By this means the skull-cap will, when replaced, rest firmly in its position without slipping back, and so causing disfigurement of the forehead. In cases of fracture of the skull the section should be completed with the saw, care being taken not to wound the dura mater. Under other circumstances the inner table may be conveniently divided with a chisel and mallet. The skull-cap must now be forcibly dragged off; if very adherent to the dura mater, a long flexible spatula may be introduced between them, and separation thus effected.

In young subjects before the sutures and fontanelles are united, it is better to remove the dura mater and skull-cap together, by dividing the former with blunt-pointed scissors in a line with the section through the bone, and then cutting through the falx at its anterior and posterior attachments.

The longitudinal sinus may now be opened and examined. The dura mater should next be divided on each side with blunt-pointed scissors, or on the level of the section through the bone, and the two lateral flaps turned up; then the falx should be cut near its anterior attachment, and the whole membrane drawn backwards off the hemispheres. The brain must now be removed; a long narrow scalpel being used to cut through the nerves and vessels, whilst the tentorium is most safely divided with blunt-pointed scissors. The spinal cord should be cut across as low as possible. Any fluid present at the base of the skull should be drawn off with a syringe and measured.

Brain.—After examining the pia mater, it should be entirely stripped off, and the surface of the brain examined. It should then be placed on its base, and, if very soft, supported by a towel wrapped round it. A horizontal incision should be carried through each cerebral hemisphere, on a level with the upper surface of the corpus callosum, from within outwards, not quite reaching the surface, so as to leave the hemispheres still attached to the rest of the brain. These should be turned aside, and numerous vertical incisions made in the upturned surface. Each lateral ventricle should then be opened by a vertical incision through its roof, and any fluid contents withdrawn by a syringe. The fornix should now be divided in front, and with the septum and corpus callosum turned backwards. The velum interpositum and choroid plexus being reflected in a similar manner, numerous longitudinal incisions should be made in the corpora striata and thalami optici, and in the corpora quadrigemina. An incision should now be made through the superior vermiform process of the cerebellum, so as to lay open the fourth ventricle. The cerebellum may be examined by making parallel incisions on each side through its lobes, not quite detaching the sections. The brain may now be folded together again, and the under surface turned up and examined. Incisions should be made into the under surface of the cerebral lobes, and into the crura and pons; and the medulla divided transversely at different levels. Softened portions should be tested with a stream of water; and parts reserved for microscopical examination at once placed in a hardening solution, such as chromic acid (1 per cent.).

A method of examining the cerebrum preferable to the above, when it is desired to determine accurately the exact seat of lesions, is the one recommended by Dr. Pitres.

The cerebral hemispheres, having been separated and stripped of their pia mater, are divided into three portions by two transverse vertical incisions, the first passing about two inches in front of the fissure of Rolando, the second a little less than half an inch in front of the internal perpendicular fissure, the occipito-parietal fissure of Huxley, which divides the parietal from the occipital lobe of the cerebrum. The cerebrum will thus be divided into three portions, an anterior or prefrontal, a middle or fronto-parietal, and a posterior or occipital. The first and last portions correspond to the non-excitable parts of the cerebrum, lesions of which do not cause either motor or sensory disturbances. The middle region, on the contrary, comprises the corpus striatum and optic thalamus, and the cortical motor zone.

This central portion may be best examined by making four vertical sections by incisions parallel to the fissure of Rolando. The first, or pediculo-frontal section, is made by an incision about three-quarters of an inch in front of the fissure of Rolando, dividing the second and third frontal convolutions close to their insertion into the ascending frontal convolution. This section will especially comprise the third frontal convolution. On its surface are seen sections of the three frontal convolutions, the anterior extremity of the island of Reil, the posterior extremity of the orbitar convolutions, the caudate and lenticular nuclei of the corpus striatum separated by the internal capsule.

The second, or frontal section, is made by an incision at the level of the ascending frontal convolution. Its surface displays a section of the ascending frontal convolution in all its extent, the convolutions of the sphenoidal lobe, the island of Reil, the external capsule and the claustrum, the caudate

nucleus, the lenticular nucleus at its thickest part, and the optic thalamus.

The third, or parietal section, is made by an incision carried through the ascending parietal convolution. It much resembles the former, but the lenticular nucleus and the claustrum are divided where they are smaller.

The fourth, or pediculo-parietal section, is made by an incision about an inch behind the fissure of Rolando at the level of the foot of the parietal lobules, and passes through the posterior extremity of the optic thalamus. The lenticular ganglion is no longer visible; the corona radiata is divided in the region where lesions produce hemianæsthesia.

By means of these sections the exact relations of lesions of the cerebrum can be made out with much greater accuracy than by the ordinary methods of examination.

Base of Skull, Orbit, and Internal Ear.—The base of the skull and its sinuses may now be examined. In cases of fracture, the dura mater should be carefully stripped off, so as to expose the surface of the bone. The contents of the orbit may be examined by removing its roof. The tympanum can be opened by cutting through with a chisel the plate of bone forming its roof. This is situated on the anterior surface of the petrous bone, just in front of the eminence of the superior semicircular canal. To examine the internal ear the petrous bone must be removed. This is best done by two converging incisions made with a saw, and then separating its apex from the sphenoid and occipital bones with the chisel.

Spinal Cord.—To examine the spinal cord the body must be turned on its face, with the head hanging over the table, and a block placed under the chest. An incision must be made over the vertebral spines from the top of the sacrum to the occiput, and the vertebral arches laid bare. These are best divided with the rachitome, a double semicircular saw, in the absence of which a short common saw may be used, or a chisel and mallet or a bone forceps. The cord should be removed in its tube of dura mater, the latter being held by the forceps, and care taken not to bend the cord abruptly. The dura mater should then be slit open with blunt-pointed scissors along its anterior and posterior surfaces, and the cord examined, with as little handling as possible, by means of transverse sections made with a sharp scalpel. For microscopical examination the cord may be placed in spirit for about twenty-four hours; and then, after removal of its membranes, cut into lengths, and transferred to a 1 per cent. solution of chromic acid.

A method of opening the spinal canal from the front, preferable in many respects to the above, is practised at Vienna and many places on the Continent. The instruments used are a strong knife-shaped chisel, with a cutting beak, and a mallet. After the removal of the thoracic and abdominal viscera, the beak of the chisel is introduced into the lowest intervertebral foramen, and by successive blows of the mallet the pedicles of the vertebræ are cut through on each side and the canal exposed by removing the bodies. In this way great disfigurement of the body and soiling of the table and linen are avoided, and the spinal ganglia are more easily examined.

Thorax and Abdomen.—The thorax and abdomen should now be examined. It is better to lay the abdominal cavity fully open before removing the sternum. In cutting through the first rib, and disarticulating the clavicle, care should be taken not to wound the innominate vein. By using cutting pliers, which should be directed so as to cut obliquely through the rib into the articulation, all danger is avoided.

If much ascites is present, the belly should be tapped before laying open the peritoneal cavity. So, if either pleura be full of fluid, which will be shown by its pouring out when the cartilages of the ribs are cut through, sufficient should be drawn off with a syringe to prevent any overflow when the sternum is removed.

The lungs should now be drawn out of the chest, adhesions separated, and their posterior surfaces examined. The contents of the mediastinum should next be inspected, and the pericardium opened. If the case be one of thoracic aneurysm, mediastinal tumour, or malformation of the heart or great vessels, the heart and lungs should be removed together. Otherwise, the heart may be first removed and examined.

Heart.—The auricles should be laid freely open with a pair of scissors, by an incision joining the mouths of the great veins and carried to the extremity of the auricular appendage. The competency of the valves may then be tested. All clots must first be removed, the heart held in an upright position, and water poured into the aorta and pulmonary artery successively, the semilunar valves being held back with the handle of a scalpel to allow the ventricle to become filled; on looking into the auricles the competency of the auriculo-ventricular valves may be estimated. To test the semilunar valves an opening must be made into each ventricle; the pulmonary artery and aorta cut sufficiently short to enable the valves to be clearly seen; and then water poured into these two vessels successively, and the valves looked at from above. The right ventricle may now be opened. The left forefinger should be introduced through the pulmonary artery, and the anterior wall of the ventricle divided with blunt-pointed scissors into the artery, the point of the scissors being guided by the left forefinger to the junction of the valves. The pulmonary artery and aorta

should then be separated as much as possible, and the left ventricle opened in a similar manner along its anterior wall, the left forefinger as before guiding the scissors to the point of junction of the semilunar valves. The incision must be carried close to the ventricular septum, and the septum between the aorta and pulmonary artery, but without cutting the latter. The most accurate way of measuring the capacity of the orifices is to pass through them graduated balls fixed on rods, in default of which the fingers may be used.

Lungs.—To remove the lungs, the trachea must be cut across at the root of the neck, and well drawn forwards by inserting the middle finger into the lower end, and the other fingers on each side behind the bifurcation, care being taken not to cut the œsophagus.

To examine the lungs, if the lobes are firmly bound together by adhesions, it is best to carry an incision in a vertical transverse plane from the outer border inwards towards the root. Further incisions may be made parallel to the first, in front and behind it. Cuts made in this direction lie in the plane of the large vessels and air-tubes.

If the lobes are separate, the incisions should be so managed as to give the largest possible sectional area. The lower lobe, as before, should be cut from without inwards, but it is usually more convenient to commence the incision for the upper lobe by entering the knife in the septum between it and the lower, and carrying the incision midway between its root and its external surface. The vessels and bronchi should be slit up by probe-pointed scissors.

Larynx and Pharynx.—To remove the larynx and pharynx, the incision in the neck must be carried up to the chin; the floor of the mouth opened from below; the left forefinger introduced, and used to depress the tongue; a long narrow scalpel introduced above the finger, and carried along each side of the ramus of the jaw; the tongue then drawn down under the chin; and the soft palate and pharynx divided transversely. The pharynx and larynx should then be opened along their posterior walls.

Intestines.—In examining the abdomen it is most convenient to begin with the intestines. The large intestines should be divided between two ligatures below the sigmoid flexure, and drawn out, cutting the mesentery close to the bowel. This process should be continued till the duodenum is reached, when it may be again tied and cut. The intestine should be opened along the line of attachment of the mesentery.

Spleen.—The spleen may next be examined. It should be drawn forwards out of the abdomen, and the gastro-splenic omentum cut through. It should then be laid on its hilum and bisected by a cut carried through the organ midway between this and its outer aspect.

Stomach.—The stomach should next be removed. A double ligature should be placed round the duodenum about two inches below the pylorus, and another one round the lower end of the œsophagus, and these tubes cut through, so as to remove the stomach without the escape of its contents. If required for chemical analysis, the contents should be emptied into a glass vessel, by removing the œsophageal ligature.

The usual practice is to lay open the stomach along its lesser curvature, from the œsophagus to the duodenum; but in many cases it is better to carry the incision along the greater curvature, for, as ulcers and cancers are more frequently situated near the lesser curvature, this incision is more likely to avoid cutting through them.

Unless required for chemical analysis, the mucous membrane may be washed by a gentle stream of water and then examined.

Pancreas. — After the removal of the stomach the pancreas may be conveniently examined. Before separating it from the duodenum the condition of its duct should be ascertained.

Liver.—In all cases of jaundice the liver and duodenum should be removed together, so as to obtain the bile-duct intact. In removing the liver care should be taken not to injure the right suprarenal capsule, which is in close contact and often adherent. In testing the perviousness of the bile-ducts it is better not to squeeze the gall-bladder, as this will often overcome an obstruction, but to open the duct with scissors, and observe the colour of the lining membrane below an obstruction. This will be found unstained by bile.

To examine the interior of the liver a number of vertical incisions should be made through the organ, extending nearly to the posterior border. The thickness of the capsule, appearance of the surface, and condition of the vessels and ducts on section should be carefully noted. The gall-bladder should also be opened up, and its contents and inner surface observed.

Suprarenal Capsules.—In cases of Addison's disease the suprarenal capsules should be removed united with the semilunar ganglia and solar plexus.

Genito-urinary Organs.—In all cases of urinary obstruction the kidneys, ureters, and bladder should be removed in connexion. The pelvic organs may be removed *en masse* by carrying a large knife all round the pelvic walls, and drawing the viscera upwards and backwards. As much of the urethra as may be required can be pulled back under the pubic arch. The urethra and bladder should be opened with scissors along their upper wall.

The uterus may be examined by introducing one blade of a pair of probe-pointed scissors through the os; making an incision

through the anterior or posterior wall to the fundus; and carrying this on each side to the entrance of the Fallopian tubes, which will be studied along with the ovaries.

The kidney may be bisected by an incision through it from the convex border to the hilum; the capsule should then be stripped off, its thickness and degree of adhesion being noticed; and the state of the surface of the kidney, both external and on section, carefully observed. W. CAYLEY.

NECROSIS (νεκρός, a dead body).—The absolute death of a circumscribed portion of any tissue; but the phrase is usually associated with death of bone. *See* BONE, Diseases of.

NEGRO LETHARGY.—SYNON.: The Sleeping Sickness of the Congo; *Maladie du Sommeil*; *Nélavane*; *Dâdane.*

DEFINITION.—An endemic disease of the West Coast of Africa, affecting the central nervous system; characterised by slowly developed and increasing muscular debility, torpor and somnolence; and terminating, after a variable period of months or years, in death.

GEOGRAPHICAL DISTRIBUTION.—This disease is confined to certain circumscribed districts of the hot, damp part of the West Coast of Africa lying between Senegambia and Loanda. How far it extends into the interior of the country is not known; that it occurs as high up the Congo as the hilly district below Stanley Pool is well ascertained. Formerly it was common as an imported disease among the negroes in the West India Islands; since the abolition of the slave trade it is unknown there. Cases have occurred in England also in West Coast negroes. A striking peculiarity about the disease is that it may remain latent for a very long time, and not declare itself until years after the endemic area has been quitted. According to the natives, the liability continues for seven years.

ÆTIOLOGY.—Sleeping sickness has been attributed, on very insufficient grounds, to a variety of causes, such as excessive venery, excessive spirit-drinking, particular kinds of food, poisoning, malaria, hereditary and racial proclivity, and so forth. None of these, on investigation, can be found to account for it. There are some grounds, however, for suspecting that it is in some way connected with the recently discovered blood-worm, *Filaria sanguinis-hominis perstans.* Certain it is that this parasite has been found in the blood in a large proportion of the cases in which it has been properly searched for. Such a cause would explain the peculiarities of the endemicity of the disease, and also the singular liability to its development years after the victim has left the endemic area.

ANATOMICAL CHARACTERS. — Records of *post-mortem* examinations are contradictory; and hitherto nothing has been discovered in the brain or elsewhere to explain the symptoms.

SYMPTOMS.—Negro lethargy attacks both sexes and all ages; it is stated to have a predilection for the young, vigorous, and intelligent of about eighteen or twenty. It commences insidiously with lassitude, muscular and intellectual debility, often moroseness, and an irresistible tendency to fall asleep at unwonted times and even while at work. Dull headache is sometimes complained of, but not always. A tottering and unsteady gait, as if from weakness, is a frequent and early symptom, as is also a peculiar and pathognomonic *facies*: the upper eyelids droop as if weighed down by sleep, the eyes are lustreless and the face puffy, and the expression is sad or taciturn. The memory becomes weak and the senses dull. Little by little, sometimes interrupted by deceptive periods of arrest or improvement, the state of torpor becomes intensified, so that after a time sleep is nearly continuous; or, if not asleep, the patient will lie with closed eyes in an apathetic condition from which he can be roused with difficulty. He may generally be got to reply to questions, but he is unable to sustain a conversation, and speedily relapses into his habitual state of lethargy. At this stage, were he not roused to take food he would starve to death; even after being roused up, so great is the somnolence that he may fall asleep again in the act of conveying food to his mouth or during mastication. There may be some evening rise of temperature; but for the most part the skin is abnormally cold, the patient evidently feeling chilly and liking to lie asleep in the hot sun. Examination fails to detect any disease of the thoracic or abdominal viscera; the fundus oculi is healthy; and the superficial and deep reflexes are preserved. Although appetite and digestion generally continue unimpaired, towards the end of the disease the body wastes; the sphincters may fail to act; and extensive bedsores may form. Limited areas of skin may become anæsthetic. Muscular tremor is frequently noted; and as the disease advances, localised muscular spasms or more general convulsions may supervene. Death may occur during one of these convulsions, or it may be brought about by simple inanition or by some intercurrent disease. A certain proportion of cases exhibit maniacal symptoms at an early stage; these may subside, or recur, or persist for a variable period before the development of the characteristic somnolence. Enlargement of the cervical glands, of the salivary glands with a degree of salivation, and an itching papular or papulo-vesicular eruption on the chest and limbs are common occurrences.

The symptoms described are not all present in every case, and the individual

features vary much in different instances, in degree and combination and rate of progress. Progress may be rapid or slow, so that the duration of sleeping sickness is variously stated at from four or five months to as many years. Cases are on record in which recovery seemed to take place, to be followed, however, almost invariably, sooner or later, by relapse and death. It is doubtful, indeed, if permanent recovery ever really does take place. The negro smitten with sleeping sickness considers himself and is looked on by his companions as doomed.

In the districts in which this disease occurs the distribution of the cases appears to be most capricious. A dozen negroes may be sleeping to death in one village, whilst the neighbouring villages are, and continue to be, entirely exempt or only slightly affected. Similarly, it seems to cling to particular houses and families, and thereby acquires a false appearance of heredity. So terrible are its visitations, that whole villages are decimated by it, and entire districts abandoned from the fear of it by their panic-stricken inhabitants.

Diagnosis.—Negro lethargy has been confounded with beriberi, a disease also endemic on the West Coast. Attention to the following points should prevent this mistake. Beriberi is characterised by a more rapid incidence; by pre-tibial œdema or varying degrees of general anasarca; numbness over the tibiæ and elsewhere; muscular hyperæsthesia, especially of the calves of the legs; breathlessness and palpitation; irregular bruits over the heart; more or less of a straddling gait; usually absence of knee-jerk; quickly developed atrophy of groups of muscles; and other symptoms which point to its being dependent on a multiple peripheral neuritis. In sleeping sickness, on the contrary, these symptoms are absent; and the characteristic somnolence and lethargy and other features clearly indicate that it is a disease affecting only the central nervous system.

Treatment.—No treatment has been found to be of any real and lasting service in negro lethargy. If in the future it should turn out that Filaria perstans is in ætiological relationship to the disease, much may be expected from an intelligent prophylaxis; for, in this case, attention to the water-supply, boiling or filtration of suspected water, and the thorough cooking of everything likely to convey the parasite, would be rewarded by immunity from the disease and perhaps its disappearance from the districts at present affected.

Patrick Manson.

NENNDORF, in Prussia (Hesse).—Cold sulphur waters.

NEOPLASMS (νέος, new; and πλάσσω, I mould).—A term for new-growths. *See* Tumours.

NEPHRALGIA (νεφρός, the kidney; and ἄλγος, pain).—Definition.—An affection of the nerves of the kidney, unattended by any evident anatomical lesion; characterised by the occurrence of pain in the region of the kidney, sometimes periodic, often accompanying exhaustion, but without any morbid changes in the urine.

Ætiology.—Exhaustion, exposure to cold, malarious poison, and the nervous, rheumatic, or gouty constitutions, are to be ranked amongst the chief causes of nephralgia. It is probable that the pains in the kidney due to the presence of calculi in its pelvis are at times of a purely neuralgic character.

Symptoms.—Neuralgic pain in the region of the kidney is sometimes paroxysmal and very intense, at other times more continued and less severe. It is frequently periodic, and is apt to occur when the patient is exhausted, or in a state of nervous depression. It is unattended by any change in the quantity or appearance of the urine, and the pain does not tend to dart down in the direction of the ureter, while tender spots may generally be discovered in the neighbourhood of the spinal column.

Diagnosis.—The disease with which nephralgia is most apt to be confounded is renal calculus. The points upon which reliance is to be placed in making the diagnosis are the exact seat of the pain, and the direction in which it spreads; the presence or absence of tender spots in the lumbar region; and the condition of the urine. In renal calculus the urine is commonly, or at least occasionally, bloody, and contains crystals or groups of crystals, or minute calculi, while in nephralgia it is natural.

Prognosis.—The prognosis of nephralgia is favourable.

Treatment.—The severity of the pain may be such as to demand subcutaneous injection of morphine. The most valuable remedy for cure is quinine, which may be given in doses of five, ten, or even twenty grains two or three times in the course of the day. Iron, arsenic, chloride of ammonium, acupuncture, or Corrigan's cautery may be employed in suitable cases, if the quinine fail.

T. Grainger Stewart.

NEPHRITIC COLIC (νεφρός, the kidney).—A synonym for renal colic, an affection which is usually due to the presence or passage of a renal calculus. *See* Renal Calculus.

NEPHRITIS (νεφρός, the kidney).—A general term for inflammation of the kidney. *See* Bright's Disease; and Kidneys, Diseases of.

NERIS, in France (Allier).—Feebly mineralised, alkaline, saline thermal waters. *See* Mineral Waters.

NERVES, Diseases of.—SYNON.: Fr. *Maladies des Nerfs*; Ger. *Nervenkrankheiten.*—Nerves, in their origin, course, and distribution, are connected with the several organs and tissues of the body, and are consequently affected in various ways when such parts are disordered or diseased. But, besides such *secondary* derangements, nerves are subject to many morbid conditions which affect them *primarily*. In the case of certain classes of nerves, connected with special functions, the effects produced by disease are at once so distinct and so important, that they require separate consideration. Such, for example, are the glosso-pharyngeal, hypoglossal, olfactory, optic, phrenic, pneumogastric, spinal-accessory, sixth and third cranial nerves, the morbid conditions of which will be found fully discussed under their respective headings. Again, certain forms of congestion or inflammation (whether occurring in the subjects of gout, rheumatism, malaria, plumbism, syphilis, or in other states), when they affect important nerves, cause symptoms of a character so marked, either in their progress or distribution or by their severity, as to deserve a special designation, and to demand separate description (*see* INTERCOSTAL NEURALGIA; NEURITIS; SCIATICA; and TIC-DOULOUREUX). In these and in other allied instances the prominent symptoms are referable to functional disturbances of the nerves. In another class of cases similar phenomena originate in interference with the general nutrition, in disease of the nervous centres, or by reflex action; and these phenomena will be found discussed in the articles upon CONVULSIONS, NEURALGIA, &c.

In this place there remain for special consideration the following subjects: (1) the effects of *injuries* of nerves; (2) the most common morbid growths involving nerves, which are generally known as *neuromata*; and (3) the effect of cutting or stretching nerves regarded as a means of *treatment*.

1. Nerves, Injuries of.—Nerves may be divided accidentally either by tearing or cutting, or surgically during an operation, or for the relief of pain or resection of tumours. The nerves most frequently divided accidentally are those of the upper extremity, especially the ulnar, and the median just above the wrist-joint. The injury is very often caused by broken glass.

Sometimes, besides being wholly or partially divided, nerves may be bruised, or have embedded in their substance particles of friable foreign bodies, such as glass or slate. Fractures of the humerus at the upper or lower third are not uncommonly complicated with injury of the musculo-spiral nerve by the sharp edge of one of the fragments; for the nerve passes spirally round and in close contact with the humerus, first on the inner, then on the hinder, and near the elbow at the outer aspect of the bone.

SYMPTOMS.—The symptoms of the division of a nerve are loss of power in the muscles, and of sensation in the skin, supplied by the branches of the injured nerve. The complete or the partial division may be diagnosed by the more or less complete interruption of their functions. It should, however, be remembered that there is often not complete anæsthesia, and that the state of the muscles is more important than is the loss of sensation.

In addition to the paralysis of motion and sensation, various changes soon occur in the parts cut off from the nerve-centres, and supply further and valuable information as to the extent of the injury.

The *muscles* atrophy with great rapidity, and in many cases shrink so as to cause various deformities. In other cases deformity results from the unbalanced active contraction of the neighbouring healthy muscles. Examined electrically, faradic contractility is found to be diminished as early as the second day, and completely lost from the third to the sixth. The galvanic contractility remains for from three to twelve weeks, but abnormally strong currents are required to produce contractions in proportion as the muscular tissue disappears.

The so-called 'reaction of degeneration' is evident within a week or two of the section, and indicates with certainty that the muscle is for the time separated from its nerve-centre.

The *skin* and its appendages also suffer. At first, on account of the section of the vaso-motor nerves the parts are flushed and hot; but, within a fortnight or three weeks, there is established a spasm of the small arterioles, resulting in diminished blood-supply and coldness of the paralysed parts. In many cases the skin becomes red, shiny, and glossy; and ulcers or whitlows may form painlessly, originating in some cases from injury to an anæsthetic part, in other cases being apparently spontaneous. The *nails* become fibrous and brittle, with ridges and fissures on them, and in some cases are shed. The *hair* breaks off short or else falls out. The *joints* are at first swollen and painful, but later on are liable to become stiff and ankylosed. The *fat* and *subcutaneous tissues* atrophy.

Changes in the divided nerve.—The lower end of the divided nerve undergoes rapid atrophy and degeneration, the myelin being broken up and absorbed and the axis-cylinders quickly destroyed. This degeneration affects simultaneously the whole of the lower end and its branches, but is in all cases succeeded after an interval of some months by imperfect attempts at repair, and the formations of new axis-cylinders from the nuclei of the sheath of Schwann. The proximal end as a whole undergoes no change, except for a slow atrophy which ensues after a lapse

of years. Its cut extremity, however, soon increases in size, and on it a bulbous swelling forms, which, in a nerve the size of the median, is about half an inch in length by a third of an inch in diameter. This bulb is formed of fibrous tissue and young nerve-fibres. If the cut ends are in apposition, *union* occurs by a growth of nerve-tissue from the nuclei of the sheath; but the process is generally a slow one, and is usually preceded by degeneration of the lower end as already described. If good apposition is not maintained, union either does not occur at all or else it is very imperfect.

Treatment.—In the treatment of nerves accidentally divided all foreign bodies are, in the first place, to be carefully removed by means of a thoroughly aseptic sponge or forceps, with as little further injury to the nerve-tissue as possible; and the wound, if practicable, is to be treated antiseptically. Then the limb should be fixed upon splints in a position which will bring most easily and closely the cut ends of the divided nerve into apposition. Chromicised catgut sutures should then be passed completely through the nerve about a quarter of an inch from the cut surfaces, and tied tightly enough to obtain good apposition, but not so as to crush the nerve-fibres. Two sutures are usually sufficient. If possible, none of the nerve-fibres should be cut away, although a slight trimming off of jagged ends may be advisable. Passive motion of the paralysed muscles should be employed as soon as the wound is united; and afterwards weak galvanism should be applied to the limb, to promote nutrition and stimulate nerve-currents. It is also of much importance to keep the parts sufficiently warm. In most of the cases so treated a good result is ultimately obtained, although it may be delayed as much as one or even two years. Sensation commonly returns before motor power, and voluntary power before electrical excitability.

In cases where a nerve has been for long divided and has not united on account of want of proper treatment by suture, the operation of secondary suture should be performed. The limb should be rendered bloodless by an Esmarch's bandage, and the separated ends exposed by a careful dissection. The greater part of the bulb should then be cut cleanly off, and the lower end should be refreshed. Sutures should then be passed as described above. The operation is sometimes tedious and difficult.

2. **Nerves, Tumours of.**—Synon.: Neuromata.

The tumours which affect nerve-structure, although no doubt varying in essential character, as they do in other parts of the body, have usually been grouped indiscriminately under the head of Neuromata. They may be divided into two classes—(*a*) *true*; (*b*) *false*.

A *true* neuroma is one which is composed of nervous tissue, and may contain medullated or non-medullated fibres, and in addition ganglion cells; all such tumours are exceedingly rare.

A *false* neuroma is a tumour situated on a nerve and not itself containing any nerve-elements. Such growths are usually composed of fibrous tissue; but myxomatous, gliomatous, and sarcomatous tumours have also been described. All neuromata are most common on the nerve-trunks of the extremities, and are generally in great measure separable from the nerve-tubules amongst which they lie. This is especially the case with the fibrous growths. The so-called *traumatic neuromata* have just been described as 'bulbs' on the proximal end of injured nerves.

Numerous cases of multiple neuromata are on record. In one case, recorded by R. W. Smith, upwards of 2,000 tumours were found. In most instances they are confined to one particular set of nerves and their branches. For instance, they have been found in the posterior tibial and plantar nerves, as in a case recorded by Van der Byl (*Path. Soc. Trans.*, vol. vi.), where the growth may have been round-celled sarcoma or cancer. In another remarkable case of multiple neuromata, recorded by Dr. Wilks (*op. cit.*, vol. x.), perhaps of syphilitic origin, a simple fibroid deposit was found within the neurilemma, causing in some places hardening and contraction, and in others neuromatous tumours. One of these had formed in the substance of the pneumogastric nerve, and was thought by Dr. Wilks to have caused the disease of the lung which proved fatal. In another case, recorded by Mr. F. Smith, multiple tumours affected the internal cutaneous and interosseous nerves of the arm, and the larger tumours were found to have undergone calcareous degeneration (*op. cit.*, vol. xii.).

Symptoms and Diagnosis.—The chief symptom is pain, and this is felt not only at the seat of growth, but also in the parts to which the diseased nerve is distributed. The pain is often of an aching character, but is also at times shooting or neuralgic. Hyperæsthesia or anæsthesia of definite cutaneous areas are less common phenomena, and muscular weakness or paralysis is comparatively seldom complained of. On clinical examination a neuroma will be found as a smooth, oval, or rounded swelling, varying in size, and situated in the course of a nerve-trunk. The tumour is more movable in the transverse diameter of the limb than in its long axis. Handling and pressure cause pain both locally and in the course of the affected nerve.

Treatment.—Neuromata on the continuity of a nerve, if painful or situated so as to be easily accessible, and liable to injury, may be dissected out carefully. Sometimes it will

be found that the tumour can be extirpated without taking away the entire thickness and destroying the continuity of the nerve, which, when a large one (as for instance the great sciatic), it is important to preserve. In case this cannot be done, the whole section of the nerve-trunk may be taken away, and the smoothly cut ends brought together with fine chromicised catgut sutures, the limb being placed in a position to relax the nerve and lessen tension to the utmost. If approximation be impossible, union may be obtained by grafting a portion of nerve, taken from an animal or from a recently amputated limb, between the separated ends.

In cases of neuromata in stumps excision is sometimes available and effective. Opening the cicatrix and dissecting out the tumour or tumours may be all that is required, and this operation should in all cases be combined with thorough stretching of the affected trunks. But in other instances the pain and tenderness are so diffused, and the growths so numerous, that re-amputation a few inches higher up gives more complete and satisfactory results. Special care should be taken that the nerve-ends are cut short, so that they may not be included in or compressed by the scar.

3. Nerves, Surgical Division and Stretching of.

(*a*) *Nerve-section.*—Synon.: Neurotomy.—Surgical division of nerves has been employed for the cure of painful affections, such as neuralgia, and for obstinate and sustained spasmodic movements. It has been usually performed subcutaneously, and most frequently in the case of the branches of the trifacial nerve, at their exit from the bony foramina, such as the supra-orbital, the infra-orbital, and the mental branches. Efforts have been directed to prevent the union of the cut nerve, by taking away a considerable portion, so as absolutely to prevent contact of the ends; and the operation then must necessarily lose its subcutaneous character. When the nerve spreads out to its distribution in all directions, it is difficult to secure this absolute removal, and a good deal of the adjacent soft parts must be excised to insure its being done thoroughly. The operation has to a great extent been given up since the introduction of nerve-stretching, and should never be performed until the latter method has been given a thorough trial. It is now generally recognised that nerve-section is useless in cases of tetanus.

(*b*) *Nerve-stretching.*—This is one of the modern modes of the treatment of disease, which has so far achieved a certain amount of success.

Method.—Nerve-stretching is effected by cutting down upon the nerve-trunk, detaching it from its connexions for the space of a few inches, laying hold of it with the fingers, or passing an aneurysm-needle beneath it, forcibly stretching the whole nerve from its origin to such an extent as to affect powerfully its functions, and then closing up the wound. In some instances a certain amount of loss of sensation or muscular power in parts to which the nerve is distributed is the immediate result; this, however, passes away after a certain interval, and the nerve-function becomes more or less completely restored.

Applications.—The most useful application of nerve-stretching is its employment for the relief of neuralgia. In many cases of facial neuralgia temporary benefit at least is secured, whilst in some a permanent cure results. It is specially indicated in the epileptiform variety of facial neuralgia, and in intractable sciatica. The sciatic nerve can also be efficiently stretched without any incision, by what is known as the 'bloodless method.' For this purpose the patient is placed under an anæsthetic, and, the leg being maintained in a position of extension, the thigh is flexed upon the pelvis, and thus all the structures passing from the pelvis to the posterior aspect of the thigh are put on the stretch. This condition of tension should be maintained for about ten minutes, and the limb should then be thoroughly massaged, the region of the sciatic nerve being especially kneaded and rubbed.

In cases of old nerve-injury or of implications of nerve-trunks in scar-tissue, the operation of nerve-stretching is most useful, but in all such cases the nerve should be exposed at the seat of injury or of thickening, and should be thoroughly freed with the knife before stretching is commenced.

In cases of motor spasm, nerve-stretching has also been employed, but with less success. Thus, it has been used for the treatment of spasmodic wry-neck, and facial tic or *tic convulsif.* In some cases also of tonic spasm and contracture the operation has appeared to be of benefit.

In tabes dorsalis, nerve-stretching was at one time much employed on the Continent, but is now fallen into disuse. It is, however, certain that some patients derived considerable benefit from its application; and although it is not to be expected that the motor incoordination will be cured, yet in cases where the lightning-pains are specially severe the operation is certainly worthy of trial.

For chronic neuritis, and especially for ascending neuritis, with thickening of the nerve-trunk, nerve-stretching is sometimes of much use, and should always be given a trial.

Nerve-stretching has also been employed with benefit for anæsthetic leprosy, and for reflex epilepsy. It does not appear to be of any benefit in tetanus, although at one time it was much advocated for the cure of this disease.

John Wood. Anthony A. Bowlby.

NERVI, in the Eastern Italian Riviera.—Warm, moist, winter climate. *See* CLIMATE, Treatment of Disease by.

NERVOUS.—A term used variously in reference to persons, to temperaments, or to morbid conditions. A person is said to be nervous, or of a nervous *temperament*, who seems to present a special susceptibility to pain, or who exhibits an undue mobility, as it is termed, of the nervous system—that is to say, when the person starts or shakes on the occasion of abrupt or intense sensorial impressions, or when he exhibits a proneness to convulsions, or manifests an exalted emotional susceptibility. An organisation of this kind characterises children rather than adults, and, amongst the latter, females more than males. Nevertheless, in persons of both sexes such a bodily disposition is frequently to be met with, varying not only in degree, but also in kind or type. As one of the most important and peculiar of these varieties, we must include the as yet very imperfectly understood condition known as hysteria (*see* HYSTERIA). A nervous disposition may be either inherited, or acquired during the life of the individual, and it then ensues as a sequence of some severe illness, of some grave anxiety, or of some physical or moral shock.

In reference to *disease*, the term 'nervous' is used with different significations in different cases. Sometimes it is used in more general terms to signify that the disease is one implicating the nervous system rather than any other part of the body. At other times the use of the term is very variable. Thus, by the term 'nervous aphonia' we imply that the voicelessness is due to some functional nervous inhibition, rather than to any distinct paralytic condition caused by structural disease; while, by the term 'nervous deafness' we should imply that the deafness is due to disease, functional or organic, of the auditory nerve or its centres, rather than to an inflammatory or other affection of the middle ear.

H. CHARLTON BASTIAN.

NERVOUSNESS.—A term applied to the state of, or to the conditions manifested by, a person coming within the description of 'nervous' as above defined. *See* NERVOUS.

NERVOUS SYSTEM, Diseases of. The complexity of the nervous system, its manifold functions, and its extensive distribution, render its diseases more varied than those of any other system of the body.

From the manner in which the nervous and vascular systems interlock, their diseases or pathological conditions are to some extent inseparably related to each other. The modes of interference with the functions of the vascular system through altered nervous action are comparatively few and simple. The heart may, under the influence of modified nervous stimulation depart from its customary order and rate of contraction, or in extreme cases cease to beat; the smaller arteries over a greater or less extent of the body may diminish in their calibre, or become dilated; but, save for such events as these and their direct consequences, the work of the vascular system is habitually carried on without variations impressed upon it by abnormal states of the nervous system.

On the other hand, the diseases of the nervous system which may be induced by altered quality of blood, or by alteration of function in the heart or some part of the vascular system, are numerous and varied. The functional activity of the system as a whole may be degraded, owing to the fact of its receiving an inadequate amount of blood from a feeble or slowly acting heart. Or the functions of a part of the system may be interfered with by an undue contraction or dilatation in its small arteries, or by an impediment to the outflow of blood, inducing a mechanical congestion. Again the complete or partial arrest of the blood-flow in the vessels of some important region (owing to thrombosis or embolism therein), or the rupture of one of the branches of such a vessel, with extravasation of blood into the organ—either of these events may impair or destroy the functions of that particular part, even if it cause no more general disturbance of nerve-function. In short, both local perversions of function, and structural changes in the nervous system, are far more frequently initiated by altered quality of blood, or unnatural phenomena in the vessels of the part, than by primary morbid changes in either of the other two components of nerve-tissue, namely, the nerve-elements themselves or their interstitial connective tissue.

But, as already intimated, the number of different nervous diseases is referable principally to the great complexity of this system. It is now a familiar fact that the same kind of morbid change existing in different parts of the nervous system tends to give rise to wholly dissimilar groups of symptoms. Hence the importance, from a clinical point of view, of studying the varied functions and functional relationships of the several parts of the nervous system.

The most practical and useful classification of the principal component parts of the nervous system is as follows:—

1. THE CEREBRO-SPINAL DIVISION (or *Nervous system of animal life*).
   - *a.* The Encephalon (Cerebrum and Cerebellum).
   - *b.* The Spinal Cord.
   - *c.* The Cerebral and Spinal Nerves.

2. THE ORGANIC DIVISION (or *Nervous system of vegetative life*).
   a. The Pneumogastric or Vagus Nerves.
   b. The Great Sympathetic System (with which is included the 'Vaso-Motor' System of Nerves).

This classification, though in part natural, is in other respects purely artificial. The cerebro-spinal and the organic nerve-centres are structurally continuous at many points. The vagus nerves, and the vaso-motor system of fibres in part, have an encephalic origin, though the latter are distributed almost throughout with the sympathetic system, of which it constitutes by far the most important part. This sympathetic system is connected at intervals with the whole length of the cerebro-spinal system, from the lumbar enlargement to the base of the brain, chiefly by connecting filaments passing between it and the anterior spinal nerves. Some of these connecting filaments are afferent, others are efferent. The brain again is brought into immediate relation with the sympathetic system through the widespread filaments of the pneumogastric nerves, which mingle with almost all the visceral plexuses, both of the thorax and of the abdomen. The spinal accessories seem to be the motor nerves through which the more direct impressions brought to the medulla by the pneumogastrics are reflected upon some of the viscera. Similarly, the transference of motor stimuli direct from the spinal cord to the viscera, in response to afferent impressions conveyed to it by certain nerves of the sympathetic system, takes place through motor fibrils in the filaments connecting the anterior spinal nerves with this system. The sympathetic system also possesses its own intrinsic motor fibres and vaso-motor centres. Other intrinsic motor centres probably exist amongst the sympathetic ganglia, which, like those of the heart, may be capable of bringing about muscular contractions in the parts with which they are severally in relation.

The direct consequence of the close relationship between the viscera and the fibres of the pneumogastric and spinal accessory, as well as between the spinal motor nerves and those emanating from the central connexions of the vaso-motor system, is that we find lesions of some portions of the cerebro-spinal system frequently involving altered actions in parts under the immediate influence of the nervous system of organic life—as when diseases of the bulb and its neighbourhood disturb the action of the heart or the respiratory processes, when vomiting is produced by cerebral or spinal disease, when diabetes or polyuria is induced by irritations of the fourth ventricle. Such effects, again, are illustrated by the flow of tears under the influence of grief, by the arrest of the salivary secretion under the influence of fear, or by the occasional production of an increased flow of the same fluid at the thought of savoury food. Or, the action of the two nervous systems upon one another may take place in an opposite direction, as when in a neurotic subject an irritant in the intestine, or the passage of a renal calculus down the ureter, gives rise to convulsions; when, according to some authorities, forms of 'reflex' paralysis are produced; when the 'spirits' are depressed under the influence of visceral disease, sometimes to such an extent as to induce melancholia; or when, on the other hand, irritative states of the ovary lead to that form of insanity known as nymphomania.

Sympathetic disturbances are also apt to show themselves in the functions of certain parts comprised within the sphere of the cerebro-spinal system itself, when some other portion of it becomes the seat of disease, though the extent to which this occurs is still involved in much doubt. Brown-Séquard believed that hemiplegia itself is often induced by an 'inhibitory' influence, emanating from some morbid portion of the brain and acting upon certain motor-cells in the spinal cord. Similarly we find an irritation occurring in one portion of the organic nervous system entailing morbid manifestations in some other and perhaps distant part of this system, as when the early stage of pregnancy or when ovarian or uterine disease leads to vomiting; when certain irritations of the stomach excite the act of coughing; or when irritations of the bronchial mucous membrane lead to vomiting. Essentially similar phenomena are seen when suprarenal-capsular disease leads to sickness; or when a blow on the epigastrium, by conveying a shock to the semilunar ganglia, causes an arrest of respiration or of the heart's action. *See* SYMPATHETIC SYSTEM, Disorders of.

This tendency to the establishment of sympathetic or related disturbance of distant parts in local diseases of the nervous system is one of the principal sources of the great complexity of the problems of diagnosis in these affections. Thus, though a lesion in the brain may give rise to a certain set of *direct* effects, the consequences of the same lesion may also, and mostly do, become multiplied by the production of what are called *indirect* effects. Such indirect effects may show themselves either in the direction of arrest or of exaltation of function in other parts of the brain or spinal cord, and in the former case they are often said to be brought about by 'inhibition.'

The proportion between the direct and the indirect effects resulting from an injury to nervous tissue varies greatly in different cases, according to the seat, extent, and nature of the lesions, as well as according to the age, sex, and general health of the

patients. Hence it often happens that the same kind of lesion seems at different times to give rise to different sets of clinical phenomena.

In regard to *diseases of the organic nervous system* our knowledge is at present extremely defective. The recognition of the diseases of this system—that is, as diseases having such or such a pathological starting-point—is beset with peculiar difficulties. This is in part attributable to the free connexions existing between the organic and the cerebro-spinal nervous system, and the consequent difficulty, so frequently arising, which opposes itself to our settlement of the question as to whether any particular group of symptoms, possibly due to some primary disease of a portion of the organic nervous system, really owns such a cause, or whether it is rather due to some disordered condition of the cerebro-spinal centres, which induces indirect effects on the side of the nervous system of organic life. Then, again, in other cases, disease of some portion of the organic nervous system may really exist, which, by reason merely of our present defective physiological and pathological knowledge, remains unsuspected as a disease having that particular nature and origin.

The nature of the functions performed by the organic nervous system sufficiently explains this difficulty. In part it serves to link the functional activity of certain viscera with sensory impressions or motor acts referable to the cerebro-spinal system, as in the processes of ordinary or disturbed respiration, parturition, &c.; in part also it brings different organs into co-ordinated activity, as when the presence of food in the alimentary canal excites the simultaneous activity of the pancreas, the liver, and other glandular organs. And how well such functions as those last-named are performed we are often only able to estimate vaguely, if at all, since the actions of those portions of the nervous system on which they depend do not reveal themselves either by sensible impressions, or by movements of parts of which we are conscious.

Other functions of the 'sympathetic' nervous system, such as those which have to do with the maintenance and regulation of the functional activity of the blood-making or ductless glands—namely, the liver, the spleen, the suprarenal capsules, the thyroid gland and the lymphatic glands—are even still further beyond the pale of recognisable phenomena. Yet disturbances of these purely organic functions may give rise to certain general affections, which we are unable to refer to morbid states or actions of this portion of the nervous system. Suprarenal-capsular disease, leucocythæmia, azoturia, diabetes, chlorosis, various forms of anæmia, and other conditions of general malnutrition, are instances of diseases possibly due to deficient or perverted action of some of these blood-making organs, immediately occasioned by morbid conditions of the sympathetic nerve-centres in relation therewith. And it may be fairly presumed that the functional activity of these organs is influenced by the nerves and nerve-centres with which they are in connexion—just as that of ordinary secretory glands (such as the parotid and sub-maxillary) is known to be under the influence of the nerves with which they are supplied.

The true pathology of such general diseases as have been named, we may hope, will be ultimately elucidated by the application of the same means as have led to our present knowledge concerning the symptomatology of local diseases in the cerebro-spinal portion of the nervous system. This means, therefore, would consist in a more searching and habitual examination of the several parts of the nervous system of organic life, so as to endeavour to connect morbid appearances in its several centres with appreciable pathological states of ductless glands and other organs, and the still further endeavour to correlate these morbid appearances with the respective states of health or symptoms exhibited by the patients during life. Slow and difficult as this method is, it is the only one (apart from the experimental method with lower animals, which is here available only to a very limited extent) that would appear to hold out any probability of ultimate success.

The obscurity prevailing in reference to diseases of the *cerebro-spinal nervous system* is not to be compared in extent with that relating to the nervous system of organic life. The reason of this is obvious. Deviations from its proper functions come much more easily under the ken of the physician and of the patient; whilst, in addition, morbid changes in this part are a few degrees less difficult to detect; and as they are situated in parts which are also much more frequently scrutinised in the *post-mortem* room, such changes are in reality far more frequently recognised than when they occur in one or other of the more scattered centres of the nervous system of organic life.

For some general remarks on the diseases of the cerebro-spinal nervous system, the reader is referred to the articles, BRAIN, Diseases of; and SPINAL CORD, Diseases of.

ÆTIOLOGY AND PATHOLOGY.—The proper and well-balanced working of the nervous system, as a whole, depends upon the maintenance of the accustomed degree of excitability in its different nerve-centres; and the proper nutrition of such centres, upon which their normal molecular mobility depends, is certainly largely dependent upon their habitually receiving a supply of blood which is definite in amount, and uniform in quality. But the amount of blood going to any tissue

or part is subject to the regulating influence of the local vaso-motor centre, with which the vaso-motor nerves supplying the blood-vessels in question are in relation. By the influence of other parts of the nervous system, or owing to the condition of these vaso-motor nerve-centres, the vessels dependent upon them may be either unduly contracted or unduly dilated. Again, the proper quality of blood is subject to much alteration in different diseases; for instance, it may be thin and poor in anæmic states, it may contain poisonous ingredients in workers with lead and mercury, whilst it may contain varied noxious constituents in those suffering from grave hepatic and renal disease, from septicæmia, and from the acute specific fevers. In this latter group there is, however, reason to believe that some of the abnormal nervous phenomena which are apt to manifest themselves may be due, not so much to the direct toxic influence of altered blood, as to the fact that in such states of the system the blood may be, at times, more prone than natural to coagulate in the minute vessels of the nervous system. Such undue proneness to coagulate sometimes depends upon the existence of an increased number of white blood-corpuscles, which, either from the state of the blood-plasma, or from the condition of the tissues outside, show a more than usual amœboid activity. Or an undue proneness of the blood to coagulate in some of the small vessels of the nervous system, during or after certain of the acute specific diseases, may be due to an unnatural tendency of the fibrin to separate from such altered blood. The nutritive changes taking place in different tissues are chemical changes, differing from one another in exact nature, and therefore capable of reacting differently upon the blood circulating through such parts. These facts suffice to show how difficult it is to draw the line between what are probably mere toxic effects of an altered blood, and those which are due in the main to minute and almost inappreciable changes in the condition of the smaller blood-vessels of a nerve-centre.

But whenever variations take place in the nutritive condition of any centre, these variations are apt to involve not only an altered action in that particular part, but a perverted functional activity of other related parts. It often happens, therefore, that an exaltation or diminution of functional activity in some one part of the nervous system causes a diminution, exaltation, or other perverted activity in distant parts of the system. Thus, owing to the many possible permutations and combinations, we may get the most varied grouping of abnormal phenomena traceable to altered actions in the nervous system, and having for a starting-point some perverted functioning of one or more nerve-centres. We have here some of the modes of production of what are commonly called *functional diseases*. Diseases of this type are specially apt to manifest themselves after some unusual strain has been thrown upon the nervous system, especially if the general health was at the same time lowered. The strain may have arisen from prolonged overwork and deficient sleep, or from some sudden mental shock, whether of joy or terror, but more especially the latter. At other times such functional diseases appear without any assignable cause, more especially in persons of a neurotic habit of body. Great differences exist amongst different individuals in this respect—that is, in their proclivity to diseases of the nervous system, though it is a matter of common observation that children and females are, as a rule, much more prone than men to become affected by nervous diseases of this type.

It is now a well-established fact that persons who are endowed with a neurotic habit of body, very frequently *transmit* a similar tendency to their children. It is not a tendency to any one particular disease, but a vulnerability of the nervous system as a whole which is transmitted, so that under the influence of even a comparatively slight strain, this weakness may manifest itself in one or other of various ways. It may reveal itself by mere general nervousness or tremors, by attacks of chorea, by epilepsy, or by one or other of the forms of insanity. When the neurotic habit of body exists to a well-marked extent, either in one or in both parents, different children may be affected in several of these modes; yet it is not necessarily so, for the inherent vigour of some of their progeny may cause such tendencies to be dwarfed and practically blotted out.

Other diseases of the nervous system are induced by definite and easily recognisable structural changes belonging to one or other of the following varieties. Rupture of blood-vessels often happens, causing *hæmorrhage* either into or upon the brain or spinal cord; though hæmorrhage into the latter organ is an extremely rare event. Or changes may occur in the vessels of some part of the nervous system, leading to their narrowing or actual occlusion by the combined influence of degenerations and thrombosis; or a similar result may be brought about by the lodgment of an embolus, and in each case the consequence, if the patient lives long enough, is the establishment of a focus of *softening* in the brain or spinal cord. In addition to these changes we have others of an irritative or *inflammatory* nature. These may affect the surface of the brain, when they are associated with *simple* or with *tubercular meningitis*; or they may implicate some deeper portion of its substance, though unfortunately we are at present only very imperfectly able to separate these inflammatory affections from the more simple degenerative softenings, either

at the bedside or in the *post-mortem* room. If, however, the inflammatory focus should subsequently become the seat of an *abscess*, the latter difficulty would disappear. In the nerve-trunks an inflammatory condition, affecting principally their connective-tissue envelopes, is not infrequently met with, and goes by the name of *neuritis*. Again, *tumours* may be found, either arising in or pressing upon some portion of the nervous system. These may have been produced under the influence of tuberculosis or syphilis, or they may be cancerous, or wholly unrelated to any general diathetic state. *Acephalocysts* or *cysticerci* are also occasionally met with pressing upon the surface, or within the substance of the brain; or fluid may accumulate within the ventricles, as in *hydrocephalus*. But a far more frequent morbid condition consists of an overgrowth of the interstitial connective tissue, leading to the formation of patches or tracts of *sclerosis* in the brain and spinal cord. This change constitutes the basis of several well-recognised morbid conditions of a progressive type. Lastly, we may have certain special forms of *atrophy* and *degeneration*, showing themselves more especially in the nerve-cells of various parts of the brain, spinal cord, or sympathetic ganglia.

TREATMENT.—For the treatment of nervous diseases we have at our disposal a number of invaluable remedies, the action of which is more or less special. Thus, we have strychnine and bromide of potassium, possessing the opposite properties of increasing and diminishing the reflex excitability of the nervous system, in addition to other beneficial modes of action. We have chloral, morphine, sulphonal, chloralamid, and other drugs, acting either directly or indirectly as hypnotics, and thus allowing the curative action of rest to come into play. We have opium and Indian hemp, subcutaneous injections of morphine, antifebrin, and the constant galvanic current as pain-subduers. We have drugs like ergot, belladonna, nitro-glycerine, and nitrite of amyl, capable of influencing the calibre of the smaller arteries. We have in conium and chloroform most powerful agents for relaxing the whole muscular system. We have iodide of potassium, which in syphilis and other cachectic states of the system seems to act as a direct antidote for the dispersion of gummatous or other connective-tissue overgrowths. Whilst in the various forms of electricity we have special agents of the highest value, not only for mitigating pain, but for allaying spasm, for improving the nutrition of wasted muscles, and for facilitating the bringing of them again under the influence of the will in cases of paralysis.

The above are only some of the chief special remedies which we employ in the treatment of nervous diseases. We have, as more general remedies—so-called nervine tonics—the preparations of arsenic, iron, quinine, zinc, phosphorus, cod-liver oil, &c.; whilst we have also frequent occasion to call to our aid ordinary tonics, purgatives, emmenagogues, anthelmintics, and counter-irritants, together with cold or tepid douches, and the shampooing or massage of paralysed limbs.

The manifestations of nervous disease are immensely influenced by the general state of health of the patient, and this not only in so-called functional, but even in the gravest of structural diseases. There is indeed no class of affections in which more good may result from a minute regard to change of air, diet, rest and exercise, amount and kind of labour, and that general attention to all hygienic details upon which those most skilled in the treatment of these diseases always largely rely. There are few chronic diseases of the nervous system, even of the most obstinate and progressive type, in which very much may not be done either to arrest or to stay their progress, by careful attention to such hygienic details, by the judicious administration of drugs, and by maintaining the general health of the patient at the highest possible standard.

H. CHARLTON BASTIAN.

NERVOUS TEMPERAMENT.—*See* NERVOUS; and TEMPERAMENT.

NETTLE RASH.—A popular synonym for urticaria. *See* URTICARIA.

NEUENAHR, in Germany.—Thermal alkaline waters. *See* MINERAL WATERS.

NEU RAGOCZI, in Prussia (Saxony).—Muriated saline waters.

NEURALGIA (νεῦρον, nerve; and ἀλγέω, I suffer pain).—SYNON.: Fr. *Névralgie*; Ger. *Neuralgie*.—This is a term applied to a disease of the nervous sensory apparatus, marked by paroxysmal pain, which is for the most part unilateral, and in the course of nerves. In many cases no evidence of change in the periphery of the nerve is discoverable, and to these the term *neuralgic* is perhaps most properly applied; in others, however, there is reason to think that inflammation of the nerve is at least the starting-point of the disorder. The diagnostic points are as yet not sufficiently certain for these cases of neuritis to be absolutely separated from those of simple neuralgia, and they may so far be considered together. Relative constancy in the pain, with paresis and atrophy of muscles supplied by the affected nerve, and swelling of the nerve-trunk, point to neuritis. *See* NEURITIS.

ÆTIOLOGY.—Neuralgia is prone to occur in families marked by neurosal tendencies, not necessarily of neuralgic character, but which display themselves in various phases

of psychical disturbance, as insanity, hysteria, hypochondriasis, or in the shape of epilepsy and chorea. Rare before puberty, that crisis has a strong predisposing influence. In the middle period of life, though first attacks are not very common, revivals of old-standing disease are apt to occur, as a result apparently of the depression occasioned by the wear and tear of life. Premature agedness (marked by atheromatous changes in the vessels, arcus senilis, permanent greyness of hair, bagging of the cheeks, pulmonary emphysema) conduces to severe and intractable neuralgias. Malaria is a potent cause. The presence of sewer-gas in a house may occasion persistent neuralgia. Anæmia and malnutrition generally, however brought about, play an important part. So also do sexual excesses, and perhaps likewise a state of celibacy. Pregnancy, over-lactation, and menorrhagia are each predisposing causes. The most frequent exciting causes are cold, especially damp cold; injury to the nerve by violence, or by the encroachment of morbid growths; syphilis; gout; and the presence of lead or mercury in the system. Irritation of peripheric organs may excite neuralgia in nerves nearly or remotely associated. So dental caries may induce supra-orbital neuralgia; indigestion may excite anginous symptoms; uterine disease may excite neuralgia of distant nerve-trunks—as, for example, the occipital; and the presence of intestinal worms may explain the occurrence of neuralgia in parts quite unconnected with the bowels. Neuralgia is a common sequel of relapsing fever and of influenza.

Anatomical Characters.—In simple neuralgia no definite lesions are discoverable—at least, none that are constant enough to deserve the place of necessary accompaniments or factors of the disease. As a result of neuritis or perineuritis the nerve-trunk is sometimes found swollen and hyperæmic; or, in a later stage, it may be atrophied and its fibres degenerated.

Symptoms.—After some little preceding numbness, cutaneous anæsthesia, or other abnormality of sensation, the import of which gets to be well understood by persons liable to neuralgia, the patient is seized with pain, which at first is not severe, and ceases quickly, but returns in a few seconds or minutes, lasting for a short time, and then remitting. These darts revive with shorter and shorter intervals, so that in a little time the pain appears to be almost continuous, or interrupted only by waves of intensity, and it will last for some seconds or more than a minute together. Then comes a respite, to be followed by recurrence, and these alternations may continue for a few minutes or as many hours. In attacks of long duration where no treatment is applied, the pains gradually get less acute, the intermissions longer, and the outbreak slides off into a confused feeling of discomfort and bruising about the seat of pain, coupled with a sense of exhaustion and desire for sleep. The character of the pain varies: it is described as darting like a knife or like lightning, crushing, hammering, boring, and sometimes burning. In neuralgia about the head the patient will often be seen to cringe and recede before the plunges of pain, as though he were receiving blows. When the pain is at its worst there is often a radiation of it to other nerves, and especially to those placed symmetrically with the one affected; but this secondary pain never attains anything like the severity of the original. Not always, but very commonly, certain definite points where pressure is exceedingly painful may be found by palpation. These, the *points douloureux* of Valleix, have a certain diagnostic importance. Rare in first attacks, they are much more common in patients who have been subject to recurrences during many years. There is always a nerve-branch under the skin at these points; and more often than not they correspond with the point of emergence of a nerve from a bony groove or opening, or its passage through a muscular aponeurosis. Pallor of the skin, followed by intense redness, horripilation, and other evidences of vaso-motor disturbance, are common. In the case of nerves being attacked which preside over glands there is often increased secretion. The tactile sensibility of the skin is almost always diminished after a time in the neighbourhood of the affected nerve, though at first there is some hyperæsthesia.

Local Varieties.—The varieties of neuralgia are divided into two primary groups, namely: I. **Superficial**; and II. **Visceral.**

I. **Superficial.**—These include the following:—

(*a*) *Trigeminal neuralgia.* *See* Tic Douloureux.

(*b*) *Cervico-occipital neuralgia.*—The posterior branches of the first four pairs of spinal nerves may be affected, but it is that of the second, the great occipital, which is most important, from its size, and the frequency with which it is attacked. Shooting pains start from just below the occiput, and run over the back and top of the head, sometimes into the external meatus, and often to the front of the head and face. Giddiness, noise in the ears, and some confusion of ideas are often associated, and frequently cause cervico-occipital neuralgia to be mistaken for commencing organic disease of the brain. It may begin by such acute tenderness of the scalp as makes it an agony to brush the hair.

(*c*) *Cervico-brachial neuralgia.*—The nerves of the brachial plexus and the posterior branches of the four lower cervical nerves are here concerned. The pains affect the neck and shoulders, or shoot down the arm to the hand, in the course of one or more of

the nerve-trunks. Painful points may be found in the axilla, over the upper part of the deltoid, at the bend of the elbow, three inches above it externally, in the groove between the inner condyle of the humerus and the olecranon, at the ulnar side of the annular ligament, and where the radial nerve becomes superficial. The ulnar nerve is that most often affected, but the neuralgia usually spreads to other trunks. This form of neuralgia is sometimes associated with the presence of carious teeth.

(*d*) *Dorso-intercostal neuralgia.* *See* Intercostal Neuralgia.

(*e*) *Lumbo-abdominal neuralgia.*—Here the superficial branches of the lumbar plexus to the abdominal walls are affected. It is less common than intercostal neuralgia, but resembles it generally. The female sex is apt to be most affected. Tender points may be found close to the spine, at the middle of the crest of the ilium, in the hypogastric region, in the groin, and on the scrotum.

(*f*) *Crural neuralgia.*—This variety is almost always met with as a complication of sciatica, being rare by itself. Pain occurs in the front of the thigh and knee, and inner surface of the leg and foot. The long saphenous branch of the anterior crural nerve is most commonly affected. This form of neuralgia is not infrequent in hip-joint disease, where it is secondary to irritation of the branches of the obturator nerve supplying the joint.

(*g*) *Obturator neuralgia* affects the inner side of the thigh.

(*h*) *Femoro-popliteal neuralgia.* *See* Sciatica.

(*i*) *Coccydynia.*—Pain in the neighbourhood of the coccyx, more properly called *coccygodynia*, especially apt to occur in women, is sometimes, but by no means always, due to neuralgia of the coccygeal plexus. *See* Coccygodynia.

II. **Visceral.**—(*a*) *Cardiac.*—A certain portion of the class of cases called angina pectoris depends upon cardiac neuralgia (*see* Angina Pectoris). There is sudden severe pain at the lower end of the sternum, darting to the back and down the left arm, or it may be diffused over the chest and affect both arms. The heart feels as though it were grasped, the face loses colour, the pulse becomes altered in character, there is cold sweating, and generally the aspect and feeling of approaching death. Such attacks may be confined to two or three repetitions, or there may be a constant tendency to their recurrence under circumstances of fatigue or strong emotion.

(*b*) *Uterine and ovarian neuralgia.*—Pain attendant upon menstruation, independent of any mechanical difficulty, is thus named. It may be excited by such sources of peripheral irritation as ascarides, leucorrhœa, renal calculus, prolapsus uteri, tumours, ulceration of the cervix, or impaction of fæces; or the sources may be in some distant part of the body. Ovarian neuralgia may be accompanied by congestion of the ovary.

(*c*) The *urethra*, *bladder*, *rectum*, *kidney*, and *testis* may each be affected by neuralgia. The last-named may result from self-abuse, or be consequent upon renal concretion. *See* Nephralgia.

(*d*) *Gastralgia.*—Abdominal neuralgia is characterised by intensity of colicky pain, occurring in paroxysms, in circumstances differing from those which induce ordinary dyspepsia. There is nearly always a history of neuralgia in some other part of the body. Vomiting sometimes, and constipation invariably, accompanies the attacks. *See* Gastralgia.

Complications and Sequelæ.—Neuralgia when it attacks mixed nerves may produce muscular powerlessness, which is not merely a shrinking from making muscular effort because of the pain attending it, but a temporary paralysis. Or there may be spasm of muscles. Long-continued neuralgia is attended by more or less atrophy of the muscles supplied by the affected nerves, which may be temporary, or, in cases where frequent recurrences of the attack take place, may be permanent. Certain forms of neuralgia, especially that of the first division of the fifth, intercostal, and sciatic nerves, are liable to be accompanied by a herpetic eruption. It is probable that these are cases of neuritis (*see* Herpes). Anæsthesia of a portion of the skin will often persist, though the pain itself may be absent.

Diagnosis.—It may be said perhaps that for pain to be strictly accounted *neuralgic* there should be no obvious cause for it, such as fever, local inflammation, tumour, or injury; it should be intermittent, or at least liable to great exacerbations, and independent of movement or any external agency; it should take the course of one or more nerves; and there should be spots painful to pressure in some of the localities already indicated. Neuralgia is distinguished from myalgia by the latter involving the attachments of a muscle, not occurring in paroxysms, but dependent upon movement; from aneurysm by careful physical examination, which is especially necessary when the pain is about the chest and loins. In chronic rheumatism the pain is diffused, and influenced by movement; and it does not affect the district of a particular nerve. Acute rheumatism is accompanied by elevation of temperature, sweating, and swelling of joints. The thermometer, and the known symptoms and signs of the several diseases, will usually at once exclude pleurisy, pneumonia, and peritonitis. Syphilitic periostitis is evidenced by the sight and touch, as well as (if it occur early in the disease) by the presence of febrile movement. Where pain in the back is supposed to be of neuralgic

origin it is important to exclude the presence of hernia. Examination should be made *per vaginam* to exclude flexions or tumours of the uterus, and *per anum* for the presence of abscess about the rectum or of malignant disease. Organic disease of the brain must be excluded by the absence of local palsy, vomiting, intellectual disturbance, and optic neuritis. The pains of Bright's disease must be carefully excluded by search for albumen, signs of arterial thickening, and cardiac hypertrophy. Spinal irritation is accompanied by pains, which, however, fail to mark the district of particular nerves, and are vague and shifting. There is hyperæsthesia of the skin over some of the vertebral spines. Locomotor ataxy is characterised by pains of lightning-like rapidity, and neuralgic in character; but they shift, and are often accompanied by a staggering gait, sometimes by diplopia. Absence of the patellar tendon reflex (the quadriceps extensor muscle at the same time responding freely to faradisation and blows), observed along with shifting neuralgic pains, is a strong indication of locomotor ataxy. The pains of syphilis in its second stage may be distinguished by the presence of fever, usually also of a rash, and by the fact that they affect many parts at once.

Prognosis.—Youth, the absence of a strongly marked history of hereditary neurosis, the fact that neuralgia has followed exposures to unusual strain, violence, severe weather, or transient defects of nutrition, and that its attacks are influenced readily by treatment, afford a favourable prognosis. The onset of the disease after middle life, and its concurrence with signs of arterial degeneration, are unfavourable as regards cure. Neuralgia of itself can scarcely be said to affect the duration of life. On the whole, neuralgia of the fifth nerve is the most persistent.

Treatment.—In patients suffering from malnutrition the diet should be ample and nutritious, and should include a fair amount of the fatty element, in the form of cod-liver oil, butter, or cream. A little stimulant may sometimes be necessary—enough to promote primary digestion; but no attempt should be made to relieve pain by its direct agency.

Where rheumatism is suspected as a cause of the neuralgia it should be treated by salicylate of sodium in twenty-grain doses three or four times a day. Two or three grains of iodide of potassium with fifteen of carbonate of sodium, taken every four hours, will often remove neuralgic pain connected with rheumatism. When malaria is suspected, it is well to follow up this treatment by quinine in doses of from five to ten or twenty grains twice a day. A mercurial purgative may be usefully combined with a dose of quinine. If there be syphilis, iodide of potassium in ten-grain doses three times a day must be had recourse to; if gout, the acetic extract of colchicum may be given in one-grain doses twice daily, coupled with saline purgatives, especially Carlsbad natural salts. The salicylate of sodium is even more useful in gout than in rheumatism. It should be given in doses of twenty or thirty grains repeated two or three times a day. Even where there is no history of malaria quinine will often be very useful, especially in neuralgia of the first division of the fifth (*see* Tic-Douloureux). The liquor arsenicalis, in doses of ♏iij, increased cautiously to ♏viij or ♏x, and the tincture of steel, in doses of ♏xxx, largely diluted with water, may sometimes be used with advantage; and the latter will occasionally succeed even when there are no ordinary signs of chlorosis. As anæmia may exist with a well-coloured face, the state of the gums and inner surface of the lower eyelid should be examined for undue pallor. Strychnine, in ♏iij to ♏v doses of the solution three or four times daily, is especially useful in gastralgia; and belladonna, in $\frac{1}{4}$ gr. doses of the extract or ♏x doses of the tincture, in neuralgia of the pelvic viscera. Seclusion from irritation of various kinds—movement, cold, noise, dazzling light, worry—should be carefully maintained in cases of trigeminal neuralgia. All sources of peripheral irritation, of which decayed teeth, foreign bodies under the skin, intestinal worms, and imperfectly fitting boots are examples, should be carefully searched for, and where practicable removed. If lead be suspected, the drinking-water should be tested, and if the mineral be found iodide of potassium may be administered. Removal from imperfectly ventilated rooms, or from exposure to noxious gases, is essential. A warm, dry climate, such as Egypt or Algeria, will often cure when all other remedies have failed. For immediate relief morphine may be injected hypodermically, either near the seat of pain, or in an indifferent part of the body. It is best used pretty freely diluted, ♏iij of a solution of acetate of morphine, 1 to 30, being commenced with, and repeated, if necessary, when the pain returns. This dose may be gradually increased to one of ♏xv, but an effort should be made to do with as little as possible and to avoid narcotic effects. The following pill is often useful: ℞ Quininæ Sulphatis gr. j, Ferri Tartarati gr. ij, Morphinæ Acetatis gr. $\frac{1}{12}$; repeated every hour or two when the onset is expected.

In all forms of neuralgia considerable relief may often be obtained by the use of small blisters (size of a florin), applied in the neighbourhood of the principal focus of pain, one following another at intervals of two days, not on but near the already blistered surface. The continuous current, derived from a sufficient number of cells of a battery to cause a characteristic feeling of burning, may be so applied that the affected nerve is

as completely as possible included in the voltaic circuit. Sponges, or leather-covered metallic disc electrodes, moistened with warm salt water, should convey the current, and be kept firmly pressed upon the skin for about ten minutes; or, whilst one is still, the other may be slid along so as to linger in turn upon each focus of pain. To avoid shock the circuit should not be broken by the lifting of an electrode till the battery is 'let down' to zero. If relief be afforded, the application may be repeated many times a day. No notice need be taken of the position of the poles (+ and −), the object of the proceeding being simply to alter the electric tension of the tissues which are made to form part of the circuit. The method is often disappointing in its results.

In rare instances, but especially in ovarian neuralgia, the hypodermic injection of atropine ($\frac{1}{120}$ gr. to $\frac{1}{60}$ gr. of the sulphate) may prove serviceable. Where there is great restlessness and irritability of the nervous system, bromide of potassium in thirty-grain doses two or three times a day should be used. Relief, in slight cases of neuralgia, is obtained by applying to the skin such liniments as the following: ℞ Chloroformi ℥ss, Tincturæ Opii ℥ss, Linimenti Belladonnæ ad ℥iij; or ℞ Spiritûs Ammoniæ Aromatici, Ætheris, Tincturæ Opii, Spiritûs Vini Rectificati āā ℥j. Aconite and veratrine benumb the sensory nerves, but they are uncertain remedies and very apt to cause irritation.

Phenazone in doses of five grains every half-hour, or from ten to twenty grains every four hours, is often very useful in neuralgia. An injection of from half to a grain of hydrochlorate of cocaine at the seat of pain will scarcely ever fail to produce at least temporary relief. Phenacetin in doses of from four to ten grains in cachets will frequently be of service. Exalgin may also be tried in doses of from two to four grains. The extract of cannabis indica, in doses of $\frac{1}{4}$ gr. frequently repeated, will sometimes produce great assuagement of suffering.

In unusually severe cases, which have lasted over years, a portion of the nerve may be excised; or, what is better, the nerve, which has been exposed by an incision, may be lifted from its bed and so firmly pulled upon as to be stretched (*see* Nerves, Diseases of). Very satisfactory results have sometimes followed this procedure. In a case, treated by the writer, of terribly severe neuralgia of the first two divisions of the fifth nerve, the operation was performed on each division of the nerve in turn, with immediate and, as far as is known, permanent relief from pain. Some time after the cure of a neuralgia there may be threatenings of a revival (dull heaviness, with tenderness of the part) following great fatigue or worry, but not immediately amounting to anything. Sleep is the best remedy for this condition, and this, if necessary, may be aided by giving ten grains of chloral hydrate.

For the treatment of coccygodynia, *see* Coccygodynia.

T. Buzzard.

NEURASTHENIA (νεῦρον, nerve; ἀ priv.; and σθένος, strength).

Definition.—A term coming lately into use to describe a peculiar form of disease, sometimes spoken of as 'nervous exhaustion,' which has been comparatively little studied, is hardly described in our text-books, but which is of immense importance, and gradually increasing frequency. The name has, and with good reason, been objected to on account of its associations, and yet no better one has been proposed. The thing itself is a very stern reality; it leads to untold misery to the patient and to all connected with her, and it requires laborious clinical investigation. Provisionally, therefore, since some name is essential, this must be used until a better is suggested.

Symptoms.—The symptoms are protean, and vary so much in different cases that no accurate description of them can be given. They are very different, in the majority of cases, from those of 'hysteria' as it is generally understood, although no doubt 'hysterical' symptoms often co-exist. Many of the cases occur in clever, emotional, but not fanciful women, who would give all they possess to be well, and heartily long for good health, if they only knew how to obtain it; and in such cases the disease is as far removed as possible from the condition known as 'hysterical.'

In a large proportion of cases the origin of the illness can be distinctly traced to some cause injuriously affecting the nervous system, such as the loss of a near relative, monetary reverses, disappointments in love, or overstrain—of late so common in the modern system of high-class education in women. In the cases, comparatively rare, but still occurring from time to time in men, a similar origin from the vexations and strains of business affairs is often observed.

The disease is not, as a rule, suddenly established, but is the gradual outcome of deteriorated health. No distinctive or invariable symptom can be mentioned, but eventually there is a continuous inability for any exertion, a constant feeling of weariness and fatigue, until at last all effort is given up, and the patient gradually lapses into a bed-ridden or sofa-ridden invalid.

The appetite fails, all sorts of vague dyspeptic discomforts—flatulence, constipation, and the like—develop; and general, often excessive, emaciation is a common condition. There is, however, a well-marked, although less common, class of case, in which, along with all the symptoms of general weakness above referred to, there is a deposit of much

unwholesome fat in the subcutaneous tissues, giving the patient a bloated, anæmic, and very unhealthy appearance. The urine is pale, of low specific gravity, loaded with phosphates, with a diminished amount of urea, and sometimes a slight trace of albumen. Other vague nervous symptoms are present, especially sleeplessness, and various vaso-motor disturbances, such as palpitation and the like. Mental and emotional symptoms are pretty sure to be developed sooner or later, and are generally fostered by the use of drugs, constant fruitless attempts at cure, the habitual resort to chloral and other sedatives, and above all by the well-meant but often highly injudicious attentions of over-anxious relatives, nurses, and, it must be added, doctors, which are rarely wanting.

Closely allied to this form of illness, and more properly termed hysterical, are a most important class of cases, in which there is a distinct imitation of real disease. Amongst these may be mentioned the so-called 'hysterical apepsia' of young girls, associated with most marked emaciation, loathing of food, and a strange unrest, leading to exhaustion of the ill-nourished muscles, or various forms of mimetic disease, such as paresis of the limbs, actual hysterical paralysis, hysterical vomiting, and the like. These, however, it is beyond the province of this article to dwell upon (*see* HYSTERIA). If the history of such cases be studied, it will be found that they shew a lamentable record of fruitless attempts at cure. The patients have exhausted the merits of all sorts of health resorts, hydropathic establishments, and medicines; they have consulted a whole phalanx of doctors; and in spite of all this they have gone steadily down-hill.

TREATMENT.—To Dr. Weir Mitchell of Philadelphia undoubtedly belongs the merit of systematising a method of dealing with such cases, based on a common-sense appreciation of their causes, which renders them no longer an *opprobrium medicinæ*, but makes their recovery as nearly certain as anything medical can be, provided only that the cases are properly selected, and the treatment is intelligently and thoroughly carried out. About this 'Weir-Mitchell' treatment, as it is often called, there is no mystery. It is essentially a systematised plan by which the weakened body is placed in thorough condition, by means of continuous rest, enforced feeding, and regular muscular waste produced by massage, which enables food to be taken and assimilated.

The essentials of this method are :—

1. Complete rest, the patient being placed in bed and kept there during treatment; and it should be a *sine quâ non* that this rest should not be in the patient's own house, but in a medical home or in lodgings, the friends and relatives, whose influence is often most injurious, being strictly excluded.

2. Regular muscular exercise to produce tissue-waste, by means of massage of the whole body, at first for ten minutes or a quarter of an hour twice daily, soon increased to an hour or an hour and a half. The influence of this is often misunderstood, and this treatment is frequently erroneously talked of as a 'massage treatment.' It should be borne in mind that massage is nothing more than a remedial agent, used for a specific purpose; that it is not the most important part of the cure; and that, used alone, and without enforced rest and over-feeding, as is unfortunately so often done, it cannot possibly be productive of any real good.

3. Feeding, which is *the most essential* part of the treatment. At first the patient should be placed on milk alone, about five ounces every third hour. Within a few days this is increased to ten ounces, so that at least two quarts are taken in twenty-four hours. Then, by degrees, solid food is added, so that within a fortnight the patient should be taking three large mixed solid meals daily, in addition to the milk, and often a cup of strong soup, with two teaspoonfuls of beef peptonoids added, twice daily as well. This exaggerated diet is continued for six weeks or two months, when it is gradually lessened, the massage also being discontinued, and the patient allowed to get up. In an average case the patient should gain from fourteen to twenty-three pounds during this time. It is strange to see how, with returning health, all invalid habits are lost, sleep becomes regular without drugs, the bowels cease to require assistance, and the whole appearance, and apparently even the nature, of the patient is altered.

At the end of the treatment, in most cases, it is advisable that the patient should go for a change, either on a sea voyage or abroad, so as to complete the cure. At any rate, she should not return to her family until her health is re-established.

It is obviously impossible to do more here than give the baldest outline of a method of treatment, the proper conduct of which requires much experience and involves great patience and trouble, but which gives results which are generally thoroughly satisfactory.

The essential point to remember is that no half-measures should be permitted: if this treatment is not carried out thoroughly and completely, it had much better not be tried at all.

W. S. PLAYFAIR.

NEURITIS (νεῦρον, a nerve).—SYNON.: Peripheral Neuritis; Perineuritis; Interstitial Neuritis; Fr. *Névrite*; Ger. *Nervenentzündung*.

DEFINITION.—Inflammation of a nerve, or of the fibrous sheath of a nerve.

Ætiology and Pathology.—This process occurs sometimes as an idiopathic change, the origin of which is altogether obscure, as where it implicates some of the intercostal or other spinal nerves, and is then often associated with an eruption of *herpes zoster* in related regions of the skin. At other times, as in some of the cases when it attacks the facial especially, or the sciatic nerve, neuritis seems to be set up as a result of local exposure to cold (*see* Facial Paralysis; and Sciatica). Such forms of neuritis as these are commonly spoken of as 'rheumatic inflammations' of the respective nerves. Sometimes this appellation may be distinctly justified; but whether such changes have necessarily to do either with rheumatism or with a rheumatic predisposition seems, in many other cases, fully open to doubt.

Contusions or traumatic causes of various kinds may also set up inflammation in nerves. At other times a neuritis may be set up and spread along the nerves leading from some wound or sloughing sore. This latter condition of things has been found to exist in some cases of traumatic tetanus (*see* Tetanus). Or an inflammation already existing may spread from some contiguous structure to adjacent nerves, as when cranial or spinal nerve-roots become involved in the course of a meningitis.

The apparently idiopathic forms of neuritis, as well as those following upon exposure to cold, are specially prone to show themselves when certain predisposing causes have been for some time in operation. Among these some of the best known and most frequently operative are the gouty diathesis, the syphilitic cachexia, and the presence of diabetes; in each of which neuritis in some form or other is of common occurrence. Other more specific predisposing causes of neuritis exist in the presence of tuberculosis, of leprosy, of epidemic influenza, or of poisoning by lead or arsenic. Many of the toxic causes, in fact, which are most effective in the production of a multiple symmetrical neuritis of parenchymatous type (*see* Neuritis, Multiple) are also capable of inducing a localised neuritis of peripheral or interstitial type, such as we are now considering—and this may vary much in intensity and also in its degree of acuteness or chronicity.

Anatomical Characters.—Strictly speaking, we have mostly to do in this pathological state with inflammation of the sheath of the nerve, or of its interstitial tissues, rather than with changes in the nerve-fibres themselves. It is possible, of course, that the nerve-fibres in this condition may undergo some distinctive pathological changes; but what is at present known is, that the neurilemma, or connective-tissue sheath of the nerve (including its minute prolongations between and around separate bundles of nerve-fibrils), becomes much more hyperæmic than natural, and that on microscopical examination there is to be found, in addition to the increased vascularity, a multiplication of new tissue-elements and the presence of migrated leucocytes. These changes may cause considerable swelling of the nerve-sheath and of its prolongations, and thus may produce either mere irritation or more or less compression of the nerve-tubules, according to the amount of new elements which accumulate in or are produced within the nerve-sheath. So that degenerative or sub-inflammatory changes in the nerve-fibres may, at least, often be found co-existing as secondary or induced phenomena.

All such changes may be localised to particular regions, or they may extend more or less diffusely along the whole length of a nerve.

These ordinary inflammatory changes in nerves pass, in syphilis, by insensible gradations, to closely allied conditions in which nerves in the neighbourhood of some new-growth become actually infiltrated therewith, as in cancer, sarcoma, or leucocythæmia.

Symptoms.—The symptoms of neuritis will necessarily vary much according to the functions with which the affected nerve is concerned. There may be impairment of special or common sensibility, or pain may exist (referred to the peripheral distribution of the nerve), with more or less distinct tenderness along its course or at its point of emergence from some bony canal. In these cases the pain is generally paroxysmal and neuralgic in character, whilst the skin is hyperæsthetic, and perhaps shows some vaso-motor or trophic changes. All these phenomena are well illustrated in diseases of the trigeminus (*see* Trifacial Nerve, Diseases of), and therefore need not be dwelt upon further here. Where a strictly motor nerve is implicated, there may be twitchings of the muscles to which it is distributed, followed by more or less distinct paralysis, and subsequently marked wasting of the affected muscles — conditions which are well exemplified in inflammations of the facial nerve (*see* Facial Paralysis). In the case of a mixed nerve being involved, both kinds of symptoms present themselves—that is, more or less severe pains and tenderness, with trophic symptoms, and distinct paresis or paralysis, with subsequent atrophy of the muscles to which the nerve is distributed. A detailed consideration of such phenomena would be needless here, as they are set forth in relation to inflammation in the sciatic nerve, under the article Sciatica; and also because all such symptoms and changes are likewise considered under the article Neuritis, Multiple.

There is, undoubtedly, an intimate relationship in many cases between different forms of neuritis and neuralgia affecting

similar sites; the reader may, therefore, be further referred to the article NEURALGIA for additional information.

TREATMENT.—The treatment of neuritis is both general and local. The general treatment is of especial importance in cases where the condition seems attributable to the influence of syphilis, and then the administration of small doses of perchloride of mercury, in combination with large doses of iodide of potassium, will often produce marvellously beneficial results. Smaller doses of iodide of potassium alone, or with colchicum, are to be given in other cases, in which rheumatism or gout may seem to be one of the factors in exciting the nerve-inflammation. But in these cases, and also in those which are simple results of exposure to cold, the cure may be often expedited, and the patient also temporarily relieved, by local treatment, such as the application of a few leeches (especially in the early stages), hot fomentations, or small flying blisters.

During the course of the treatment special symptoms may become all-important. Thus, pain may become so agonising as imperatively to demand measures for its relief; and, where paralysis is one of the symptoms, galvanism or massage (or perhaps both) must be employed daily, or two or three times a week, in order to prevent as much as possible the muscles from degenerating whilst the pathological condition in the nerve is being cured —that is, in cases in which a cure is possible. All these indications, however, will be found more fully considered under the articles SCIATICA; and NEURITIS, MULTIPLE.

H. CHARLTON BASTIAN.

NEURITIS, MULTIPLE.—SYNON.: Polyneuritis; Peripheral Neuritis; Fr. *Paralysies Périphériques*; Ger. *Multiplex Neuritis*; *Neuritis Acuta Progressiva.*

DEFINITION.—A nervous affection characterised by various motor, sensory, and trophic symptoms; dependent upon disease occurring simultaneously, or in rapid succession, in the peripheral terminations of nerves in various parts of the body, under the influence of extrinsic or intrinsically derived toxic agents of one or other kind.

This is a very important affection, concerning which our knowledge has been very greatly increased during the last twelve years. On its clinical side only the affection has, however, been much longer recognised. The first to describe the symptoms of its most common form seems to have been Lettsom, in his *History of Some of the Effects of Hard Drinking*, published in 1789. Other merely clinical descriptions of different forms of the disease were given by J. J. Jackson of Boston, in 1822, and by Chomel in Paris, in 1828; but the first case in which a widespread disease of peripheral nerves was found at a necropsy as a cause of sensory, motor, and trophic troubles was not recorded till 1864, and then by Duménil of Rouen. After an interval other cases were published, and in 1881 an important memoir was issued by Leyden, since which date our knowledge of the whole subject has rapidly increased. The gain thereby to practical medicine has been great, since it has enabled us to recognise many frequently recurring affections which were formerly either not at all or very imperfectly understood, and which were for the most part vaguely referred to affections of the spinal cord. It has shown us, further, how to recognise the symptoms due to peripheral neuritis, which occur not infrequently as complicating conditions in the course of such affections of the spinal cord as locomotor ataxy or acute spinal paralysis. The great diversity of the symptoms met with in multiple neuritis was doubtless one of the main causes accounting for the late recognition of the real nature of affections which are now found to be of such common occurrence. Moreover, as our knowledge of affections of the spinal cord became more complete, there was also naturally a disposition to look beyond it for the causes of symptoms which, in spite of our present highly refined methods of examination, could not be traced to changes in that organ.

ANATOMICAL CHARACTERS.—The morbid changes that occur in the nerves in this disease are met with principally at their finer terminations, or, it may be, even exclusively there. Where the larger branches of the nerves are also involved, the intensity of the process generally diminishes as we recede from the periphery. A second peculiarity is that the changes are most frequently symmetrical on the two sides of the body, whether the nerves affected be in the limbs, where they are by far the most frequently involved, or in other parts. A third peculiarity is that the inflammatory or degenerative changes are found to occur essentially in the nerve-fibres themselves, rather than in their sheaths or interstitial tissues: or, in other words, that the inflammatory changes are in the main parenchymatous, rather than interstitial as they are in simple neuritis. Of course these two kinds of change do not occur singly in either case, but in multiple neuritis it seems plain that the parenchymatous changes are distinctly in excess, and they are believed also to be primary rather than secondary degenerative changes due to strangulation of the nerve-fibres higher up, as some have imagined. Though primary parenchymatous changes may be the rule, we may still admit the occurrence also of secondary degenerative changes in the nerve-fibres.

The naked-eye changes in the appearance of the nerves may not be great: that depends in part upon the amount of co-existing in-

flammation in their connective-tissue envelopes, and in part also upon the severity and duration of the inflammatory process in the nerve as a whole. But even where they are not notably swollen and hyperæmic, the nerves may be deficient in their proper lustre, and irregular in contour, owing to accumulations of fat derived from degenerated myeline; or, in later stages still, they may be wasted and reduced to mere connective-tissue strands. It may often happen, however, that no very appreciable changes are to be detected by the naked eye, and that, in order to establish the existence of multiple neuritis, the finer branches of the nerves have to be dissected out and submitted to careful microscopical examination.

Where changes exist in the sheath and interstitial tissues of the nerves, they are such as have already been described in the article NEURITIS, consisting in the main of increased vascularity, some amount of exudation of serum, migration of leucocytes, and multiplication of nuclei in the sheath of Schwann and elsewhere. The distinctive changes that occur in multiple neuritis are, however, those which take place in the nerve-fibres themselves. These agree in almost all respects with the changes that occur in the 'secondary degeneration' of a nerve on the distal side of a section or other severe injury. The myeline first becomes cloudy and granular, and then undergoes segmentation—first into large and subsequently into smaller and smaller masses, until at last there is left only a number of fatty-looking globules and particles surrounding the swollen and altered axis-cylinder. As this process advances, the sheath of the nerve gives way here and there; surrounding cells swell, and, taking up the fatty particles, become converted into 'granulation-corpuscles'; whilst ultimately the axis-cylinder may be more or less completely destroyed. These changes may be most easily displayed by Ranvier's process, which consists in soaking some of the slightly teased or dissociated nerve-fibres in a 1 or 2 per cent. solution of osmic acid, which colours the myeline black and fixes it. The nerves are then to be placed for some hours in a solution of picro-carminate of ammonium, which will colour the nuclei and axis-cylinders left unstained by the osmic acid. Larger branches of nerves may be best examined when hardened and embedded, so that transverse sections can be cut. Then the two kinds of change will come well into view with the aid of the microscope—that is, more or less of alteration in the sheath and interstitial tissues, together with the atrophic conditions of the nerve-fibres themselves. Comparison with sections of a healthy nerve will help to render these changes very obvious.

However extreme the changes in the nerves may be, it is now certain that, in periods of from six to twelve months or more, complete regeneration may take place, just as it has been observed to occur in experimental lesions in the lower animals. New axis-cylinders become formed in continuity with the old, and these subsequently become surrounded with sheaths of myeline. Thus it is that the prognosis in a given set of symptoms caused by peripheral neuritis is so very much better than it would be if the symptoms had been dependent upon similarly severe lesions occurring in the spinal cord itself.

Atrophic degeneration of muscles, in relation with the affected nerve, progresses *pari passu* with the changes in the latter. The muscle-fibres waste from the occurrence of fatty and granular degeneration, while the nuclei of their sheaths multiply, and hyperplasia of tissue-elements also takes place in the intervening connective tissue.

Occasionally in some of the worst cases, in which death has occurred, it has been established that small changes of different kinds occur also in the spinal cord. Such changes have been found more especially in the cases of multiple neuritis caused by alcohol, lead, arsenic, diphtheria, and chill; but they may well occur also where multiple neuritis follows in the wake of other causes. The changes met with have, for the most part, consisted of atrophic conditions in the great ganglion-cells of the anterior cornua, together with some amount of overgrowth in the surrounding neuroglia.

In addition to these more or less essential changes, other morbid conditions might be expected in internal organs, varying widely in their nature in different cases, in accordance with the varying conditions under the influence of which the multiple neuritis has been established; that is, we may meet with visceral changes due to previous alcoholism, to malarial poisoning, or to some antecedent acute specific disease, as the case may be.

ÆTIOLOGY AND PATHOLOGY. — The best-known forms of this disease are undoubtedly due to the action of poisons circulating in the blood upon the peripheral terminations of nerves in different parts of the body, and especially upon those of the extremities. The evidence of this mode of causation is so strong for so many forms of the affection, that it is now pretty legitimately conjectured to be, in one way or another, applicable to all of them—that they are, in fact, all toxic forms of paralysis, though capable of being arranged into different groups according to the nature, or the mode of production, of the toxic agencies in question. From this point of view the best-attested causes of multiple neuritis may be roughly classified in the following manner:—

A. *Poisons of Extrinsic Origin.*—Alcohol; Bisulphide of Carbon; Arsenic; Lead.

B. *Poisons evolved by Microbes associated with various Infective or Endemic Diseases.*—Diphtheria; Variola; Typhoid

Fever; Typhus Fever; Measles; Beriberi; Septicæmia; Malaria; Influenza; Tuberculosis; Syphilis; Leprosy.

C. *Poisons evolved during Metabolic Processes occurring in some of the Organs and Tissues of the Body itself.*—Chill; Excessive Muscular Exercise; Diabetes mellitus; Gout; Cachectic states; Idiopathic or 'Spontaneous' Cases.

The cases belonging to (A) the first category supply, of course, the clearest evidence that multiple neuritis is due to the presence of poisonous substances circulating with the blood, and thus exerting an irritative influence on the peripheral nerves. The diseases comprised in (B) the second category, in the course of which, or as sequences of which, multiple neuritis has been found to occur more or less frequently, are all of them associated with the growth and multiplication of micro-organisms either in the blood or in some parts of the body. Under such circumstances it is well known that alkaloidal substances of a poisonous nature (toxines) are more or less abundantly produced, as excreted products, during the life-activity of the micro-organisms, which substances, finding their way into the blood, may act upon the peripheral nerves in much the same manner that alcohol does. It is well known that such effects do not occur in all cases, but only in a comparatively small proportion of the cases of each of these diseases. We must, therefore, suppose that, in the cases in which multiple neuritis is produced, there has either been some variation in the nature of the poisons finding their way into the blood, or else that the ordinary poisons associated with the several diseases are aided by the co-existence of one or more favouring conditions. In regard to the third category (C) of cases, in two of them at least it is known that the blood is especially apt to be altered in composition, and to contain products which may exercise an irritative influence upon the peripheral nerves in some parts of the body. The excess of uric acid in the blood may operate in this way in gout; while in diabetes the irritative effects upon the nerves are not supposed to be due to the presence of an excess of sugar in the blood (since the frequency of the association of the disease with neuritis bears no regular relation to the amount of sugar contained therein), but rather to the presence in the blood of some other acid or ethereal products (derivatives of β-oxybutric acid), such as are known to occur at times in association with diabetes. It seems perfectly certain, also, that some of the cases of multiple neuritis are set up after exposure to chill and cold; just as, in other subjects, acute spinal paralysis may be engendered under similar conditions. These are the cases of so-called 'rheumatic' origin; and it is conjectured that in them some poisonous product is formed within the system, as a result of the chill, which, according to individual proclivity or the nature of the products engendered, excites either multiple neuritis or acute spinal paralysis, or it may be both; just as, under other individual conditions, the malady excited is an acute articular affection, or an acute inflammation of some other internal organ. Lastly, in certain cachectic or anæmic states of the system there is a tendency to the occurrence of neuritis; and perhaps it is principally to this kind of causation or to the occurrence of slight exposure to cold that we may ascribe the so-called idiopathic or 'spontaneous' cases of multiple neuritis—that is, cases for which no very distinct cause of a toxæmic character can be assigned.

If we omit the ætiologically obscure cases last referred to, it will be seen that all the conditions under which multiple neuritis is prone to occur are states of the system in which poisons of one or other kind would be circulating with the blood; and such a mode of origin for the inflammatory condition of the nerves is rather confirmed by the fact of the remarkably symmetrical distribution of the neuritis that is so commonly met with in these cases, and to which reference has already been made.

We must not omit to mention, moreover, the fact of the relation supposed to exist between Raynaud's disease and peripheral neuritis. Whilst referring to the article on that disease (*see* RAYNAUD'S DISEASE) for further information, it need only be said here that multiple neuritis may or may not show itself as an epiphenomenon rather than as an essential constituent of this remarkable morbid condition.

Then, again, it should be said that 'acute ascending paralysis' (Landry) has been held by some, and especially by the late Dr. Ross, to be one of the idiopathic forms of multiple neuritis. From the clinical point of view there is undoubtedly much to be said in support of this doctrine, but the proof of this position has yet to be established by future clinico-pathological investigation. *See* SPINAL CORD, Special Diseases of.

Multiple neuritis occurs with all degrees of severity, not only at different times under the operation of the same kind of cause, but also very notably under the influence of the different causes that have been above enumerated. The latter difference is so striking that the several causes above referred to may, from the point of view of the average intensity of the multiple neuritis that they are prone to cause, be divided into two classes, as follows:—

Causes of more Intense Forms of Multiple Neuritis.—Beriberi; Alcohol; Chill; Diphtheria; Variola; Excessive Muscular Exercise; Typhus Fever; Typhoid Fever; Measles; Influenza.

Causes of Slighter Forms of Multiple

Neuritis.—Bisulphide of Carbon; Lead; Arsenic; Malaria; Septicæmia; Tuberculosis; Syphilis; Leprosy; Diabetes Mellitus; Gout; Cachectic states.

The cases of multiple neuritis that occur under either of the first class of causes may be, and often are, well-developed typical forms of the malady; those, on the other hand, which occur from one or other of the second class of causes are much more habitually ill-developed and more or less localised forms of the affection, and in some of these cases (especially those associated with leprosy, syphilis, or gout) it is the sheath and interstitial tissues of the nerve, rather than the nerve-fibres themselves, which are most prone to be affected. In these cases, also, the inflammation is often not limited to the peripheral twigs, but may involve the main trunks and the roots of the nerves. In all respects, indeed, there is in these cases often more the characters of a local neuritis than of the more general affection.

It should be borne in mind, again, that in many of the cases of multiple neuritis there may have been more than one cause in operation; thus, alcohol and anæmic conditions of the system or syphilis may co-operate with tuberculosis; chill or lead with alcohol; or local exposure to wet and cold may reinforce syphilis or gout in the production of some of the more localised forms of multiple neuritis.

In the more intense forms of the affection lesions may occur in the spinal cord as well as in the peripheral nerves. This is notably the case in some of the 'rheumatic' forms of the disease, and in some of the cases due to lead, diphtheria, or some other of the acute specific diseases. Neither in the more intense nor in the more localised forms of the disease are we able definitely to bridge the gap which lies between our knowledge of the ætiology and that of the morbid anatomy of this affection—we are unable to say anything definite, that is, as to the exact pathogenesis of the changes in the peripheral terminations of the nerves or in the spinal cord. No light whatever is really thrown upon this obscure subject by the hypothesis that functional changes in spinal trophic centres first occur, which lead secondarily to the observed failure or perversion of nutrition in the peripheral nerves. It would only shift the difficulty farther back, even if this hypothesis explained (which it does not) the localisation of the changes in the nerves to their peripheral terminations. As it is, we can only suppose that the tissues affected, and the particular parts of them, are, by their individual constitution, especially prone to be irritated by the presence in the blood of the various poisons to which we have referred.

Multiple neuritis from one or other of the causes mentioned may occur at almost any age; but the disease is by far the most frequently met with some time between the twentieth and the fiftieth year.

Some separate description or mention must now be made of the different forms of multiple neuritis.

A. **Cases due to Common Poisons.**—*Multiple neuritis due to Alcohol.*—This is the commonest of all the forms of multiple neuritis, and it is met with also much more frequently in women than in men. Spirit-drinking seems to be most prone to excite it, and especially when spirit is taken in small or moderate quantities continuously over long periods, and when at the same time there has been little exercise in the open air. Whilst alcoholic neuritis is more common among women, delirium tremens is more frequent among men—differences which may be dependent partly upon sex, but perhaps more notably upon the different habits of the two sexes, especially in regard to extent of open-air exercise.

Symptoms.—The onset of the affection is generally gradual, being often preceded for months or weeks by gastric symptoms, insomnia, and rapid pulse, together with numbness and tingling, shooting pains, tremors, cramps, and some paresis of the limbs—especially of the lower limbs. Actual loss of power may then come abruptly at any time, at first in the feet and legs, later on in the thighs—though, often before they become involved, the hands and arms also show signs of paralysis, which is most marked in the extensors of the wrists. In many instances the paralysis may stop here; but in the more severe cases it gradually advances so as to involve the nerves supplying the trunk muscles, some of the cranial nerves, and at last perhaps the phrenic nerve.

The 'dropped wrists,' and the 'dropped feet' as the patient lies in the recumbent position, are very characteristic of multiple neuritis; and the paralysis of the limbs is almost always of the flaccid type. The affected muscles speedily become flabby and much wasted. When in this condition they show a more or less modified electrical 'reaction of degeneration.' They usually cease to respond to faradism; and if they respond at all to galvanism, it is only to very strong currents, and that in a slow, sluggish manner, the reaction to A.C.C. being greater than that to C.C.C. In some exceptional cases, and in the early stages of the affection generally, the electrical reactions may be very little altered.

Various disturbances of sensibility cause the greatest distress to the patient. The limbs are often the seat of excruciating pains, the skin is more or less generally hyperæsthetic, and the muscles also in the affected parts are extremely tender, even to slight pressure. There is often, moreover, marked tenderness along the course of the nerves, so that the patient is apt to cry out

when touched or moved even in the gentlest manner. In addition, various paræsthesiæ, such as tingling, numbness, and formication in the limbs, are mostly present. In the more severe cases these latter symptoms may disappear during the height of the malady, when anæsthesia becomes developed, but may be expected to return as recovery advances. With cutaneous anæsthesia of the limbs, often localised to the terminal portions or to the areas of particular nerves, there may also be more or less marked loss of muscular sense. Some of the special senses may also be affected, especially vision, leading to amblyopia and contraction of the field for colour-vision. Occasionally, also, inequality and slight contraction of the pupil has been met with, and very rarely optic neuritis. The cutaneous reflexes are often present, but may be lost where the anæsthesia is marked. The knee-jerks are commonly lost at an early stage of the affection; but occasionally, in exceptional cases, they are found to be retained, and even to be slightly exaggerated, for a time.

In many of the slight cases of the disease a certain amount of incoördination as well as paralysis can be recognised; and in the cases in which the involvement of the muscular sense is more than usually marked, a slight ataxic condition is produced in both the arms and the legs, but especially in the latter. This, in combination with other symptoms present, such as the pains in the limbs, the loss of the knee-jerks, unsteadiness when the eyes are closed, and a somewhat peculiar gait, causes the patient's condition to resemble more or less closely that met with in locomotor ataxy. Such cases are now spoken of as *pseudo-tabes*; and, although they may be met with in multiple neuritis from any other cause, they seem to be rather specially frequent in the alcoholic form of the disease. The points which enable us to distinguish these forms from true tabes will be referred to later under the head of 'Diagnosis.'

Vaso-motor and trophic symptoms occur in some cases about the feet and hands, in the form of œdema, lividity, glossy skin, and more or less profuse sweating. Later on, the limbs are still further altered, especially in old neglected cases, by the occurrence of contractures of the fingers and of the calf-muscles, due to weakness of the extensors. Bed-sores are usually absent; and power over the sphincters of the bladder and rectum is commonly retained.

In the early stages of alcoholic neuritis there is another class of symptoms of great importance commonly present, namely, those of cerebral type. These are sometimes most marked, and of a very varied character. There may be loss of memory, loss of ability to concentrate the attention, together with illusions and hallucinations—especially towards evening and at night, when insomnia is often most obstinate and very exhausting to the patient. In some cases there may be distinct delirium continuing for days; and, even where this is not present, there is often a peculiarly active imagination, together with a sort of waking dream-like state. Thus, patients will give circumstantial details of imaginary events in which they have taken part, or of visits which they have paid within the last hour or so, when they have been quite incapable of even leaving their beds. In the course of a week or so, under proper treatment, such symptoms will gradually subside. The patient will then (or earlier where the more acute symptoms are absent) show distinct evidence of a lowered *morale*. Statements about their habits in regard to alcohol are almost always unreliable, often flagrantly untrue, and made even in the face of the strongest evidence to the contrary. We must look to the relatives or the associates of the patient if we are to obtain correct testimony in regard to this matter.

The *course* of the disease in alcoholic neuritis is pretty constant, though its duration is extremely variable, according to the degree of severity of the attack. After a slow or more abrupt onset the symptoms go on increasing up to a certain point; then there is a decline of the more urgent symptoms in a gradual fashion; after this the patient may remain in a more or less stationary condition for many months; finally, a period of slow improvement sets in, during which the tenderness of the muscles abates, and their nutrition and power improve, the anæsthesia diminishes, and with it there is a return of numbness and tingling in the hands and feet. The duration of the disease varies from two or three months to from one to two years.

Multiple neuritis due to Bisulphide of Carbon.—Delpech was the first, and is still the principal, authority concerning the effects of bisulphide of carbon upon the system (*Nouv. recherch. sur l'intoxication spéciale*, Paris, 1860). He showed that the effects of this compound upon the system were somewhat similar to those of alcohol. The symptoms are principally met with in rubber-factory operatives. It appears that intense frontal headaches are common among workers in rubber, even though no further symptoms develop. As the intoxication proceeds, according to F. Peterson, 'giddiness and even actual drunkenness become manifest, the workpeople becoming excitable, talkative, and hilarious. Among later chronic manifestations are multiple paresis, due to a multiple neuritis, mental weakening and apathy, amblyopia, tinnitus, formication, anæsthesia of the feet, muscular cramps, occasionally convulsions, at first increase of sexual appetite, later impotence in men and sterility in women' (*Bost. Med. and*

Surg. Journ. Dec. 6, 1892, p. 325). In this same communication Peterson records three cases of acute mania resulting from inhalation of the fumes from a mixture of bisulphide of carbon and chloride of sulphur. The poisonous effects from the use of these chemicals are now obviated to a considerable extent by maintaining a more thorough ventilation in rubber factories.

Multiple neuritis due to Arsenic.—It has been long known, from experiments by Orfila, that in certain cases paraplegic conditions were induced occasionally after the taking of large doses of arsenic. Of late years it has been ascertained that the poisonous effects of arsenic are sometimes very similar to those produced by alcohol. The paralytic effects thus produced were previously ascribed to changes in the spinal cord; but it has now been ascertained that such changes are only occasional, and that the majority of the effects to which we are referring are due rather to peripheral neuritis. These effects occur sometimes, though only very rarely, after the patient has taken for a prolonged period small doses of arsenic, such doses at last giving rise to symptoms of acute poisoning. Then, after a variable interval—some days, or a week or two—the symptoms of peripheral neuritis begin to develop. In other cases, however, such symptoms may set in a short time after acute poisoning by arsenic, when the drug has been taken in excess either accidentally or with suicidal intent. A typical case of this latter type has recently been brought before the Medical Society of Berlin by H. Jolly. The patient had, in August 1892, taken with a view to suicide, a quantity of Schweinfurth green. There was immediate vomiting, and for two days symptoms of gastritis. She remained very weak, and noticed, when she attempted to rise on the fifth day, some numbness of the feet. Then followed paræsthesiæ simultaneously in feet and hands, with a creeping sensation that was at times very painful. These symptoms continued during the next few weeks, and to them were soon added a more distinct weakness, especially of the lower extremities. After four weeks the patient was unable to walk alone; and when, in the following week, she was admitted into the hospital for nervous diseases, she could only walk when supported on both sides. There was also marked ataxy. The knee-jerks were lost on both sides, and there was great paresis in the legs, with specially impaired movement in the feet and toes. In six weeks the paralysis of the feet and toes was complete; there was atrophy of the muscles of the calves of the legs, and great disturbances of sensibility. The patient was insensible to slight touches, but felt stronger touches well; and there was pronounced hyperalgesia. The tips of the fingers were quite anæsthetic, and there were sharp pains in the hands and in some of the deeper parts of the forearm and arm. In the course of the following week the symptoms became somewhat worse, especially the pains. A feeling of coldness was also complained of in the right upper extremity, and there was profuse sweating in the palms of the hands. From about the twelfth week onwards a decided improvement began to take place in regard to both motor and sensory symptoms.

The superficial reflexes in arsenical polyneuritis are mostly preserved, while the knee-jerks are lost; the legs also are commonly more affected than the arms. There is much variation met with in the symptoms of individual cases, and in some of them distinct impairment or loss of muscular sense and ataxic symptoms are fairly well marked (pseudo-tabes). In almost all respects, in fact, the symptoms of the multiple neuritis due to arsenic are found to accord closely with the alcoholic form of the disease, with the very important exception that the head symptoms, with hallucinations and delirium, are generally absent. Almost all cases ultimately recover, and the duration of arsenical polyneuritis is rather shorter than that of the form due to alcohol.

Multiple neuritis due to Lead.—The effects of the multiple neuritis caused by lead are still more localised. There is not only the absence of the characteristic group of head symptoms, but a still further common limitation of the neuritis to the motor nerves, and especially to those of the upper extremity. The ordinary effects of peripheral neuritis due to lead will be found described under Lead, Poisoning by. The symptoms closely resemble those due to spinal-cord disease, to which, indeed, some of the effects are often partly attributable. For, though peripheral neuritis is the lesion commonly met with, it happens here even more frequently than with other forms of multiple neuritis that lesions in the anterior cornua of the spinal cord are also produced; and it is to those latter lesions that the symptoms are occasionally, in part at least, attributable.

But although it is the rule for the effects of the multiple neuritis due to lead to be thus limited to a part of the field of distribution of the motor nerves of the upper extremities, it is not invariably so. Thus, muscles about the shoulder and arm (especially the deltoid and brachialis anticus) may be affected as well as those of the forearm; and occasionally even some of the leg muscles, especially the long extensors of the toes and the peronei muscles. Again, in some cases of multiple neuritis due to lead there have been distinct disturbances of sensibility, that is, more or less severe pains, some tenderness of affected muscles, and perhaps also along the affected nerves, together with tingling and numbness in their field of distribution. In certain other cases of multiple neuritis due to lead

we may have the association of a more or less marked hemiplegic condition, in which hemianæsthesia is well developed. This latter condition is generally of more or less brief duration, and is supposed to be due to some functional defect in the brain, analogous to that occurring in hysteria. In this connexion, it must not be forgotten, moreover, that intense double optic neuritis and also convulsions may occur in the course of lead poisoning.

B. Cases due to Microbic Poisons.—*Multiple neuritis associated with, or sequential to, certain Infective or Endemic Diseases.*—The cases belonging to this category are those forms of multiple neuritis which are associated with, or, as is by far the most common, are sequential to, one or other of the following morbid conditions, namely, diphtheria, variola, typhoid fever, typhus fever, measles, beriberi, septicæmia, malaria, influenza, tuberculosis, syphilis, or leprosy.

Almost all these varieties of the disease were formerly ascribed to morbid conditions, either functional or structural, of the spinal cord. It is true, indeed, that functional diseases as well as certain structural affections of the spinal cord, in the form of indurations (scleroses), softenings, hæmorrhages, together with limited inflammations or atrophic conditions of the anterior cornua, are especially apt to occur occasionally as sequences of one or other of these diseases. But since the clinical characteristics of polyneuritis have been more commonly appreciated, it has been recognised that these particular groups of symptoms occur not infrequently as sequences of one or other of the diseases above mentioned—the truth of this diagnosis having, moreover, been often confirmed by necropsies which have demonstrated the presence of multiple neuritis, mostly alone, but more rarely with some co-existing changes in the spinal cord.

The severity of the disease varies very much indeed in this category of cases. Sometimes it presents itself as an acute progressive affection involving all the limbs, and subsequently the nerves supplying the trunk muscles and those of the face and eyes, together with a well-marked association of sensory symptoms of the usually varied character. At other times, and especially after diphtheria, the motor paralysis is less marked, and symptoms of a more ataxic type present themselves (pseudo-tabes); while, in other cases still, we may have to do with a localised rather than with a more generalised neuritis. The forms of multiple neuritis associated with diphtheria are apt to occur, on different occasions, in each of these types; the severe general cases, however, in which death may occur from paralysis of the diaphragm are rare and exceptional; while localised forms of paralysis limited to the palate, and associated with slight paretic or ataxic conditions are by far the most common (*see* DIPHTHERIA). On the other hand, in beriberi we have to do much more frequently with a generalised form of neuritis, in which speedy death occurs not at all rarely (*see* BERIBERI). In other of these diseases, such as variola, typhus and typhoid fevers, measles, septicæmia, and malaria, polyneuritis supervenes rarely; but in each of these affections it may appear in a well-developed form.

Again, it seems clear that in influenza, tuberculosis, syphilis, and leprosy, in the absence of other co-operating causes, the neuritis that occurs is apt to present itself in a more or less localised form; and, in the case of syphilis and leprosy more especially, the neuritis is principally of the peripheral and interstitial type. These forms of the disease are thus, perhaps, rather more closely allied to ordinary neuritis than to multiple neuritis. Still, it seems probable that both syphilis and tuberculosis may decidedly favour the action of other more potent causes, such as alcohol or chill, in the production of well-marked multiple neuritis.

The only one of these forms of multiple neuritis to which any special reference need be made is that which may be associated with malarial poisoning. Sometimes this, either alone or aided by other causes, such as exposure to cold or excess of alcohol, induces ordinary forms of multiple neuritis of medium severity, affecting the arms and legs, but especially the latter. At other times, however, malaria gives rise to what since the description given by Romberg has been known as 'intermittent paraplegia.' This remarkable affection has been found to occur only in patients suffering from malarial poisoning. It is characterised by the sudden onset of paralysis in the lower extremities, which may or may not be accompanied by some anæsthesia and paralysis of the sphincters. After some hours the paralysis disappears, perhaps accompanied by the appearance of a critical sweat, and reappears in a more or less regular manner, according as the attack assumes a quotidian, tertian, or quartan type. This affection has been found to be very amenable to treatment by quinine. Cases have been recorded by excellent observers, such as Hartwig, Erb, and Westphal, and it is now generally believed that, instead of being due to altered functional conditions of the spinal cord (which was the interpretation formerly given), this remarkable transitory and recurrent form of paralysis is dependent rather upon a peripheral neuritis occasioned by some poison formed during the course of a malarial attack.

C. Cases due to Autogenetic Poisons. *Multiple neuritis sequential to Chill.*—The disease from this cause not infrequently supervenes in an acute fashion, and may at the onset be associated with distinct febrile

symptoms, the temperature rising to some point between 101° and 103°. There may also be pains in the back, limbs, and joints, so as to give rise to the suspicion perhaps of a commencing attack of rheumatic fever. To such symptoms may be added headache and anorexia, together with tingling and numbness in the fingers and toes, and more or less tenderness over the principal nerves in the limbs. The legs and arms subsequently show an increasing paralysis, commonly beginning first in the legs. Then paralysis may spread to the trunk muscles, and to those of the tongue, palate, and larynx (so as to impair deglutition and articulation), even if it does not extend to other cranial or to the phrenic nerves. The knee-jerks are speedily lost, the paralysed muscles soon waste, and their electrical reactions become altered in the usual manner. At the same time various sensory disturbances become developed, such as tenderness of the muscles and hyperæsthesia of the skin (soon to be followed by, or intermixed with, areas of anæsthesia); while glossy skin, increased sweating, and other trophic symptoms may also make their appearance.

These cases subsequently pursue much the same course as severe cases of alcoholic neuritis. Death may occur in the course of a week or ten days from respiratory or cardiac paralysis; or, all fever having subsided, the patient may remain in a tolerably stationary condition for several weeks, before the usual slow improvement begins to set in.

In other instances the multiple neuritis following chill may be less acute and less severe, and the amount of sensory symptoms is very variable. When the latter are very slight, such cases are apt to be mistaken for those of acute spinal paralysis; and when they are more severe (especially where there is much involvement of the muscular sense) the symptoms are more of an ataxic order, so that the case may present itself as a form of pseudo-tabes.

Multiple neuritis sequential to excessive Muscular Exercise.—Although typical cases have been recorded, verified by necropsy, seemingly referable to this cause, they are nevertheless of extremely rare occurrence. So far as the form and course of this variety of multiple neuritis are concerned, it seems to agree most closely with that induced by chill, and different cases are liable to individual variation in much the same manner.

Multiple neuritis associated with Diabetes, Gout, or with Cachectic States.—Each of these varieties of multiple neuritis is liable, though only very rarely, to occur as a more or less generalised affection. As a rule, however, it is much more common for the neuritis when associated with either of these affections, and when other co-operating causes are absent, to occur in a limited form, affecting only some one or two nerves—the inflammation that is established being also peripheral and interstitial rather than parenchymatous in type. Gout has been long known as a common predisposing and even exciting cause of ordinary interstitial neuritis.

Multiple neuritis of 'spontaneous' origin. Every now and then ordinary attacks of multiple neuritis, sometimes severe and sometimes slight, make their appearance without its being possible to assign them to any of the known causes of the disease, and for which, in fact, no distinct cause can be traced. These are the so-called 'spontaneous' or idiopathic cases of multiple neuritis.

Complications.—Looking to the varied conditions under which multiple neuritis may arise, it is only natural to expect that the complications should be rather numerous; and this they are found to be. As poisoning by alcohol is the cause of so very large a proportion of the cases of multiple neuritis, we have principally to do with concurrent complications assignable to this cause. Thus the patient may suffer from obstinate symptoms of gastric catarrh, or the liver may be enlarged and hard, or smaller than natural, and other indications of cirrhosis of this organ may exist. It must not be forgotten, moreover, that in the cachectic subjects of chronic malarial poisoning there may be enlargement of spleen as well as of liver. Other complicating effects of alcohol may be due to a chronic or subacute meningitis, the existence of which leads to a great aggravation of the head symptoms in the form of delirium, or even to a chronic maniacal condition; whilst in other cases complicating symptoms, due to chronic or subacute spinal meningitis or degenerative conditions of the spinal cord, may be present. Here also—as where gout, or lead, or both combined, have been operative causes of the multiple neuritis—we may find distinct evidences of co-existing renal disease. Pneumonia and phthisis are also frequently present as complications, the latter supervening even in cases where it does not seem to have been present as a cause.

Diagnosis.—It is the great variety in the symptomatology of multiple neuritis, and the fact that it may be associated with actual disease in the spinal cord, which give rise to the principal difficulties in the way of diagnosis. Very many of the cases, however, are so typical in the combination of symptoms presented, as to allow little room for doubt in regard to the proper diagnosis. Thus, more or less paralysis of both feet and both hands, with 'foot drop' and 'wrist drop,' or more extensive paralysis of all four limbs of a flaccid type, associated with pains, numbness, and tingling; hyperæsthesia of the skin, marked tenderness of the limb muscles and perhaps also along the principal nerves, together with absent knee-jerks and the altered electrical reactions which have been

described, form such a typical combination that it should be considered to be indicative of multiple neuritis from some cause. And if with this grouping of symptoms there co-exists the combination of cerebral symptoms previously noted, we may feel just as certain that we have to do with a multiple neuritis caused by chronic alcoholic poisoning, even though no distinct evidence of this be at first forthcoming—nay, even though excess in alcohol may be firmly denied by the patient and her friends.

It will be seen that the diagnosis of multiple neuritis from spinal diseases is in the great majority of the cases easy, because pains in the former are mostly prominent symptoms, and because locomotor ataxy is the only form of spinal disease associated with severe pains that could easily be mistaken for multiple neuritis, and that only with certain exceptional forms of the disease. For there are only four other spinal diseases in which pains in the limbs are apt to constitute prominent symptoms. These are the paralyses associated with cancer of the vertebræ, with scrofulous pachymeningitis, and with cervical hypertrophic pachymeningitis—in each of which (not to mention other characteristic features) there are generally present exaggerated knee-jerks and ankle-clonus—and the somewhat rare affection, syringomyelia, which is almost always characterised by loss of painful and of thermal sensibility in the parts principally affected, whilst in multiple neuritis these are almost always modes of sensibility that remain unaffected.

There are, however, three varieties of polyneuritis which are especially liable to give trouble in regard to diagnosis. These are, in the first place, acute cases due to chill or to over muscular exercise, in which there happens to be an almost complete absence of pains and other sensory symptoms. Here the condition has to be diagnosed from acute spinal paralysis, or even from acute ascending paralysis. The second set comprises those of the pseudo-tabetic type, in which pains are present, and the diagnosis has to be made from locomotor ataxy. The third class consists of mixed cases, in which multiple neuritis is actually complicated with lesions in the spinal cord or its membranes, or in both. Here there may be at times much room for doubt as to the nature of the affection—that is, whether it is in the main spinal, or in the main peripheral, and to what extent the symptoms of the two conditions can be separated from one another.

(1) The cases of acute spinal paralysis may agree with some of the more acute cases of polyneuritis in the rapid mode of onset, with or without slight febrile symptoms, in the existence of an atrophic and flaccid form of paralysis in the limbs, together with a more or less complete electrical 'reaction of degeneration' and abolition of knee-jerks. In other forms of polyneuritis, however, the onset is apt to be more gradual and progressive, even in the most acute cases; there is also much more frequently a bilateral symmetry in the parts affected; and even the cases that are most free from sensory symptoms are almost never quite free from such accompaniments, though this is the rule with cases of acute spinal paralysis. Of course it is only in the early days of these affections that there is room for doubt. After the first few days the progress of the two affections is commonly different. Thus, in acute spinal paralysis the loss of power is at first widespread and simultaneously caused, though after a few days there is a subsidence of the paralysis in some of the parts first attacked. Whilst in multiple neuritis there is a progressive increase in the area of the paralysis during one or more days; and after the paralysis has attained its full development there is no recession of paralytic symptoms till a distinct interval of weeks, or it may be months, has elapsed.

The other disease that may have to be thought of in the early days of one of these acute cases of multiple neuritis is the rare affection known as acute ascending paralysis, concerning which so much doubt exists as to its real nature (*see* SPINAL CORD, Special Diseases of: Acute Ascending Paralysis). This form of disease may be distinguished by the complete absence of sensory symptoms, by the preservation of the knee-jerks, and by the fact that the paralysis does not progress in the same way that it does in multiple neuritis: in the former it is a more strictly ascending disease, affecting the trunk muscles after the legs, and then involving the arms; whilst in the latter the order is almost invariably legs, arms, trunk, and there is also rather less tendency for the bulbar centres to be affected. A little later on, if any doubt should still remain, the absence of muscular atrophy and the preservation of normal electrical reaction would definitely settle the diagnosis in favour of acute ascending paralysis.

(2) In reference to the diagnosis of cases of pseudo-tabes from locomotor ataxy, it should be borne in mind that these exceptional forms of multiple neuritis are met with principally after poisoning by alcohol or arsenic, or in the form that is sequential to diphtheria. And then, in reference to the conditions presented, although there may be many characters common to the two affections, there are generally marked differences in the total symptomatology. Thus, in the more rapidly developed pseudo-tabes there are not the characteristic lightning-pains, but more enduring pains, with much more of tenderness in muscles and nerves, together with numbness and tingling in the hands and feet. There is more frequently hyperæsthesia in the limbs, perhaps mixed with patches in

which there is analgesia as well as anæsthesia; there may also be some amount of atrophy of muscles, with altered electrical reactions in the direction of the 'reaction of degeneration.' Then, again, there is the absence in multiple neuritis of three signs which are commonly present in locomotor ataxy, viz. the Argyll-Robertson condition of pupil, and temporary bladder symptoms, together with loss of sexual desire and power. A girdle sensation is also much more likely to be absent in these forms of multiple neuritis, though it has occasionally been met with; and then, again, the lost knee-jerks may return during recovery from multiple neuritis. There still remains the question of the differences in gait characteristic of the two affections. What is known as the *steppage* gait (or the high-stepping gait) has been described as distinctive of multiple neuritis. Its peculiarity is due to the loss of power in the flexors of the ankle, and the consequent dependent attitude of the toes, so that the patient has to lift the foot high, as though he were stepping over a slight obstacle; whilst in locomotor ataxy, the toes, instead of being dependent, are raised, the heels being generally brought to the ground first, and also in a more irregular and spasmodic manner. Where present the steppage gait is doubtless a sign of value, but it is not always present when it is most wanted in this ataxic class of cases, that is, where paresis of the flexors is, as often happens, present only to a very slight degree.

(3) In other cases, where spinal and peripheral lesions co-exist, it may be much more difficult to recognise the real nature of the affection, or, if this can be done, to say which symptoms belong to the one and which to the other set of lesions. In regard to cases where thrombotic softenings, myelitis, or small hæmorrhages co-exist with multiple neuritis (as they may do, more especially, in some few of the cases sequential to the acute specific diseases), it can only be said that such cases are too complicated to be considered here, and that there are no forms of disease where the aid of an expert is more required in order that a correct diagnosis may be made. It may, however, be added that there are four signs in particular which, when present, may safely be considered to depend in the great majority of cases upon spinal rather than upon peripheral lesions: these are, paralysis of the sphincters, bed-sores, exaggerated knee-jerks with ankle-clonus, and, though less certainly, girdle sensations.

It should further be borne in mind that there are two affections especially in which the co-existence of peripheral with spinal-cord symptoms is common, viz. acute spinal paralysis and locomotor ataxy. So that where, by reference to the points already laid down, it can be recognised that we have to do with symptoms of double origin, the point to be considered is, whether the central or the peripheral symptoms are primary, and which are merely complicating phenomena. This is a point of considerable importance in regard both to prognosis and to treatment. It is highly important, for instance, to know, in an affection caused by exposure to cold, whether the symptoms are in the main peripheral, or whether they are in the main spinal but with some complicating peripheral neuritis. So also it should be remembered that the ataxic cases of multiple neuritis (cases of pseudo-tabes) stand at one end of a series of cases, and at the other stand the somewhat rare cases of locomotor ataxy in which symptoms due to peripheral neuritis are altogether absent; whilst between these extremes we have almost every kind of transition, furnished either by cases of locomotor ataxy with an increasing number of peripheral lesions, or by cases of pseudo-tabes due to multiple neuritis complicated perhaps by some spinal lesions. The more the patient's symptoms are of peripheral origin, the greater is the relief that is to be expected from treatment.

Prognosis.—Many indications relating to prognosis have already been given, so that little requires now to be added. It may be said, however, that in the great majority of cases life is not imperilled by multiple neuritis. But exceptions to this rule occur in the case of the severer forms of beriberi, and also in the more acute cases occurring in this country, due either to chill, alcohol, or diphtheria, in which the respiratory muscles (including the diaphragm), and the heart, are apt to become paralysed. Otherwise death takes place in multiple neuritis almost solely from the co-existence of one or other of the complications to which reference has previously been made. As to the question of ultimate cure, this, if the cases are not too old and neglected, may in the majority of instances be effected after a prolonged course of treatment. Slight cases may, of course, be cured in the course of a month or two; but in the more severe forms of the disease twelve or eighteen months at least may be required. It is indeed surprising to see the extent to which recovery occurs in this class of cases, even when they are of the worst type, as compared with the amount of improvement that could alone be expected if a similar amount of paralysis with muscular atrophy had been due to spinal rather than to peripheral disease. The signs of commencing improvement to be looked for during the stationary period of the disease are a return of the tingling and numbness in the hands and feet, increased ability to move these parts, together with a gradual improvement in the electrical reactions and in the firmness and size of the muscles, as well as a progressive diminution of the glossiness of

the skin and sweating in the hands and feet. The return of previously lost knee-jerks may also be looked for.

TREATMENT.—In all cases of multiple neuritis we should, before commencing systematic treatment, have thoroughly decided, as far as it may be possible, what the causal conditions are that have been influential in producing the neuritis, as the first necessity may be to put a stop to some poisoning of the system. It is of the greatest importance to arrive at this knowledge as early as possible, as the longer the poisoning lasts the more protracted and obstinate is the resulting malady. Thus, a rubber-worker should be taken away from his work at once. Steps should be taken to protect the patient from lead or arsenic if either of these have had to do with its development; or, as is most frequently the case, where alcohol is the cause this should at once be cut off completely, whenever the condition of the patient will admit of it. But if too great weakness of the heart be present to permit of this being done, the alcohol should be greatly reduced in quantity at first, and as soon as possible cut off altogether.

In alcoholic cases also, where we have to do with severe pains, mental disturbance, and insomnia, together with gastric symptoms, the greatest care is needed. The latter symptoms may be best checked by keeping the patient upon a strict spoon diet, pancreatising the milk and beef-tea if necessary, and administering only very small quantities at a time. In the more urgent cases it may be needful at first to have resort to nutrient suppositories. Sleep should be ensured, and the other symptoms relieved as soon as possible by giving morphine, either by subcutaneous injection or by mouth; or, in cases where the symptoms are less urgent, by the administration of full doses of bromide of potassium. At the same time, we must do our best to relieve the local pains and tenderness, by the application of light warm anodyne fomentations, by wrapping the limb in cotton-wool and oil-silk, or occasionally by the use of cold evaporating lotions, if these seem to give more relief to the patient.

In the acute stage of the disease which follows chill, where there are febrile symptoms and perhaps some slight general pains, relief may be derived from salicylate of sodium or salol, given for a few days in full and frequently repeated doses as for rheumatic fever; bromide of potassium may also be given with these drugs night and morning where the restlessness is great and headache is severe. The patient should be kept upon spoon diet as long as the temperature remains at all elevated; and in all the more severe forms of the disease a water-bed is desirable.

In the less severe cases, to whatsoever cause they may be due, the patients should be kept at rest in bed, partly with a view to warding off any aggravation of the disease, and partly to protect them from cold. In these cases, and also in the more severe forms of the disease, after the acute pains and tenderness have subsided, the diet must be more abundant, though easily digestible and nutritious. Pains may be relieved and sleep favoured by such drugs as acetanilide or phenazone, though where insomnia continues these remedies may be supplemented by bromide of potassium, chloralamid or sulphonal. At the same time, much may be done by means of tonics to improve the appetite and general health, where, as is so often the case, this has been much impaired by the previous causative conditions. When these have taken the form of malaria, gout, or syphilis, some special treatment may be necessary; otherwise we must trust principally to combinations of iron with small doses of arsenic and strychnine, aided by extract of malt and cod-liver oil. In cases where there is no marked anæmia, iodide of potassium in six- to eight-grain doses may be given with arsenic and strychnine instead of the compound of iron, at this stage of the disease, as it may help to allay pains and relieve any accompanying condition of interstitial neuritis. During all this time, in alcoholic cases, alcohol in every form should be entirely forbidden; and to ensure the absolute observance of this order the strictest precautions must be taken. No trust whatever can be placed in the patient in such cases, and injudicious friends (or servants who may be bribed or threatened) should be guarded against. The patient ought to be under the absolute charge of thoroughly reliable nurses, either at home or in some private institution or hospital.

Local treatment must also be assiduously carried on week after week, and month after month, at this stage of the disease. As soon as the tenderness has sufficiently subsided to permit of it, daily massage and gentle passive movements should be had recourse to, and to this very shortly should be added warm or sulphur baths two or three times a week, and the regular application of galvanism to the atrophied muscles. Even if they do not respond much at first to any currents that can be used without causing pain, the galvanism should be persevered with, and after a time the muscles will begin to respond.

From the first, care should be taken to prevent, as far as possible, the limbs getting into a contracted position. Thus, the knees are apt to be drawn up for the relief of pain in the early stages of the affection, and, if allowed to remain in this position, contractures with rigidity will inevitably result. The 'dropped foot' from weakness of the anterior tibial muscles soon becomes associated with slight contraction of the calf muscles and shortening of the tendo Achillis. This defec-

tive position of the foot may, however, be obviated to a considerable extent if care be taken from an early stage to prevent the foot falling forward by means of some suitable support. Contractions of the wrist and fingers must also be obviated as far as possible. This is best ensured by an early resort to passive movements and massage; and the same means will generally suffice gradually to overcome contractions that may have occurred at the ankles or the knees. Where the former are obstinate, they will in time generally yield when efforts to stand are commenced, and the weight of the body is day by day brought to bear upon the contracted tendo Achillis. It is very rare indeed that section of tendons becomes necessary.

H. Charlton Bastian.

NEUROMA (νεῦρον, a nerve). — A tumour connected with a nerve. *See* Nerves, Diseases of.

NEUROSES (νεῦρον, a nerve).—Synon.: Fr. *Névroses*; Ger. *Nervenleiden.*

Definition.—Affections of the nervous system occurring without any material agent producing them, without inflammation or any other constant structural change which can be detected in the nervous centres: in other words, functional affections of the nervous system.

Many of the disorders which may be included here are characterised by symptoms such as neuralgia, convulsions, &c., which also accompany other disorders associated with morbid changes. It is very necessary, therefore, in inquiring into any particular case, not to rest satisfied with the presumption that the disorder is functional until the condition of the nervous centres has been investigated; lest, regarding the symptom as the disease, the central mischief to which it is due may be overlooked. It is highly probable, moreover, that many of what we now regard as functional diseases will, on further investigation, be found to depend upon some corresponding change in the organ affected—an inference which is being daily verified.

Enumeration.—The neuroses may be classified according to the organs or functions involved:—

(*a*) *Visceral neuroses*, namely, those of the respiratory, circulatory, or digestive organs.

(*b*) *Localised paralyses*; for instance, palsy of the facial and other peripheral nerves.

(*c*) *Localised involuntary or reflex movements*, such as spasm of the facial nerve and writer's cramp.

(*d*) *Disorders of general sensibility*, including the various forms of neuralgia—trigeminal, cervico-occipital, sciatic, crural, &c.

(*e*) *General neuroses*, namely, chorea, epilepsy, catalepsy, hysteria, and allied affections.

(*f*) *Disorders of the mental faculties*—hypochondriasis, melancholia, and other forms of mental derangement.

P. W. Latham.

NEUSCHMÉCKS.—*See* Schmécks.

NICE, on the French Riviera.—Warm, dry, bracing, winter climate. Temperature 50° F. *See* Climate, Treatment of Disease by.

NICTATION / **NICTITATION** } (*nictito*, I wink often).—A rapid involuntary winking of the eyelids, usually due to some nervous disturbance. *See* Chorea; and Facial Spasm.

NIEDERBRONN, in Lower Alsace. Muriated saline waters. *See* Mineral Waters.

NIEDERSELTERS (Selters), **in Nassau.**—The well-known muriated alkaline table waters. *See* Mineral Waters.

NIGHT-BLINDNESS.—*See* Nyctalopia.

NIGHTMARE.—This is a condition characterised by an abiding sense of discomfort or extreme uneasiness, occurring in the midst of a disturbed sleep, sometimes associated with a feeling of weight at the epigastrium, in conjunction with more or less definitely oppressive dreams. It is principally associated with the taking of a heavy meal or of indigestible food before going to sleep by some persons, especially those of a nervous temperament, whose digestion is weak. A closely allied condition is, however, apt to be met with as a consequence of brain-exhaustion and chronic disturbance of sleep in those who are overworked, by application either to study, business details, or literary pursuits. Such a condition also has its affinities with certain forms of incipient delirium, occurring either in various febrile diseases or as a result of alcoholic excesses. *See* Sleep, Disorders of.

H. Charlton Bastian.

NIGHT-SIGHT.—*See* Hemeralopia.

NIGRITIES (*niger*, black).—Synon.: Fr. *Noirceur*; Ger. *Schwärze.*—*Nigrities cutis* signifies blackness of the skin. It may be of various degrees; and results from aberration of deposit of pigment, or, more exactly, from an excess of black pigment in the integument. *See* Melanopathia.

NILE, The.—A very dry winter climate. Mean temperature, winter, 57° F. Unsuitable for cases of active pulmonary disease. *See* Climate, Treatment of Disease by.

NIPPLE, Diseases of.—Synon.: Fr. *Maladies du Mamelon*; Ger. *Krankheiten der Brustwarze.*—Some of the more ordinary affections of the nipple will be found described under Breast, Diseases of; and

LACTATION, Disorders of. Here it is proposed to treat of certain graver diseases, which claim a separate consideration.

Malignant Disease.—The nipple may be the seat of epithelioma, which commonly commences as a crack or fissure, with an indurated base, often in the areola or at its junction with the nipple. It presents no special features which distinguish it from similar disease of the integument of adjoining parts. Hard carcinoma too may attack the nipple, involving its deeper structures, and producing general induration and enlargement, so that the diseased mass projects from the summit of the breast like a knob or large nut. The disease probably originates in the epithelium of the galactophorous ducts, or in that of the sebaceous glands.

Of greater interest than either of these is an affection frequently associated with malignant disease of the breast, to which Sir James Paget has drawn attention—an *eczematous* condition of the nipple and areola. It may occur in the form of a dry, scaly, or branny eruption, affecting the entire surface of the areola and nipple, which is darker coloured, a little firmer, and less pliant and elastic than its fellow. Or, with more characteristic signs of inflammation, small vesicles or pustules may form, and, breaking or being rubbed off, may leave behind them tiny scabs or ulcers, or a surface raw and red. Either condition may exist for many months or even years with little alteration, and with scarcely any tendency to spread beyond the margin of the areola. But the second form, causing more irritation than the first, is often subjected to treatment; and being very difficult to cure, is sometimes so severely treated with caustics that destruction ensues, not of the disease, but of the nipple, which appears to have been gradually eaten away by the eczematous affection. Both forms are uncommon, but they are rare before the middle age. A study of their clinical and pathological characters leads to the conclusion that they are due to inflammation. The disease has been noticed in men as well as women.

TREATMENT.—This disease may be treated by protecting the parts with a carefully adjusted, ventilated shield, and by the application of vaseline, or liniment of lead and oil, or similar soothing dressing. But it is very intractable, in some cases apparently incurable. It might seem as if an affection so trivial were not worthy of so much attention; but unfortunately there appears the strongest reason to believe that these conditions of the nipple and areola are not infrequently the precursors of carcinoma of the breast, sometimes by only a few months, more often by a period of years. It is probable, too, that the carcinoma is directly due to the eczematous disease; for it induces changes in the epithelium of the ducts which can be traced deeply into the substance of the breast, whose acini become at length distended with proliferating epithelium. On this account it has been proposed, when all the lesser methods of treatment have been used in vain, to remove the entire breast. Opinions, which are divided on the necessity of this measure, so severe, are united in its favour when, with the superficial inflammation, there exists an appreciable induration, however slight, within the breast. Care must be taken not to confound these eczematous affections of the nipple and areola with those more widely diffused surface inflammations of the breast, with which they have little in common, either in the obstinacy with which they resist treatment, or in the deeper disease to which they may give rise.

HENRY T. BUTLIN.

NOCTAMBULATION (*nocte*, in the night; and *ambulo*, I walk).—A term for sleep-walking. *See* SLEEP, Disorders of.

NOCTURNAL EMISSIONS.—Involuntary emissions of semen occurring during sleep. *See* SEXUAL FUNCTIONS IN THE MALE, Disorders of.

NOCTURNAL INCONTINENCE. Involuntary escape of urine during sleep. *See* MICTURITION, Disorders of.

NODE (*nodus*, a swelling).—A circumscribed swelling on the surface of a bone, connected with the periosteum, and usually due to syphilis. *See* BONE, Diseases of; and SYPHILIS.

NODI DIGITORUM (Latin).—Swellings of the distal phalanges of the fingers, usually supposed to be associated with gout. *See* GOUT.

NOMA (*νομή*, a corroding sore; from *νέμω*, I devour).—SYNON.: Fr. *Nome*; Ger. *Wasserkrebs*.—A synonym for cancrum oris. *See* CANCRUM ORIS.

NOSE, Diseases of.—SYNON.: Fr. *Maladies du Nez*; Ger. *Nasenkrankheiten*.

The diseases affecting the external and more superficial structures of the nose are described separately under their respective heads. *See* ACNE; ACNE ROSACEA; COMEDONES; ECZEMA; &c.

The present article will be mainly devoted to the diseases of the nasal fossæ, septum nasi, and the accessory nasal cavities, namely, (1) Acute Rhinitis; (2) Chronic Rhinitis; (3) Hypertrophic Rhinitis; (4) Atrophic Rhinitis, with (4*a*) Ozæna; (5) Diseases of the Septum; (6) Diseases of the Accessory Nasal Cavities; (7) Syphilis; (8) Lupus and Tuberculosis; (9) Rhinoscleroma; (10) Diphtheria; (11) Glanders; (12) Foreign Bodies in the Nose; (13) Parasites; (14) Tumours; and (15) Post-nasal Adenoid Growths.

1. Acute Rhinitis.—SYNON.: Acute Nasal Catarrh; Coryza.

ÆTIOLOGY.—Among the exciting causes of acute congestion and inflammation of the nares are direct local irritants, such as the inhalation of pungent vapours, or contact with acrid substances. Acute rhinitis is also associated with specific eruptive fevers. It is seen as a special catarrh in measles; it is combined occasionally with the pharyngeal inflammation of scarlet fever; it occurs sometimes in small-pox; and it often forms a prominent symptom in epidemic influenza. Certain drugs induce an acute nasal catarrh, more especially iodide of potassium.

When excretion is defective, the circulation in the blood of irritant products is another potent cause. So attacks of acute nasal congestion are met with among the many phases of gout. There is, moreover, in certain persons an individual and special susceptibility to nasal catarrh, which is often seen as a distinct family trait, affecting many members, and running through different branches.

Acute nasal catarrh is more commonly met with in the form of coryza or febrile rhinitis, of abrupt onset and limited course. This is generally ascribed to chilling of the surface by exposure to cold. The immediate cause, however, which provokes any individual attack cannot always be clearly determined. Cold is the most palpable exciting influence in many cases; while in others the vitiated air of crowded rooms, with defective ventilation, may be the initial irritant. It is not unreasonable to infer that the vaso-motor disturbance which dominates the invasion stage of this affection may in different instances be incited by any sudden extremes of temperature, whether the quick transition be from warmth to cold or from cold to excessive heat.

SYMPTOMS AND COURSE.—The symptoms accompanying the onset of coryza are a sense of chilliness, irritation of the nares, dryness, tingling, itching, and sneezing. The nose soon becomes blocked, due to rapid swelling of the mucosa and engorgement of the erectile tissue. The sudden obstruction to nasal respiration produces a sense of oppression with mouth-breathing, which intensifies the already commencing dryness of the throat and post-nasal space. A serous discharge now makes its appearance; the swelling temporarily subsides, and freer breathing is restored. Alternations of this thin watery flow with fluctuating nasal obstruction, sneezing, frontal headache from venous congestion or extension of the catarrh to the frontal sinuses, impairment or loss of smell, conjunctivitis, tinnitus, or deafness from obstruction of the Eustachian tubes, characterise the course of the affection. There is slight rise of temperature during the first day or two, and always a feeling of dulness and lassitude. The duration of the attack is brief, being generally limited to a week, and often ending in a few days.

TREATMENT.—The attack may sometimes be cut short at the invasion by rest and sedatives. Confinement to bed is advisable during the acute period. Among abortive remedies, opium is one of the most effectual. To quickly arrest the catarrh, and relieve the local irritation, five minims of laudanum or of the wine of opium, given every hour for two or three doses, will often afford more prompt relief than a full dose of Dover's powder taken at night after a hot foot-bath, which plan is better adapted to the later febrile stage. Thirty grains of bromide of potassium, or ten grains of hydrochlorate of quinine with a quarter of a grain of hydrochlorate of morphine, if given at the first stage of seizure, may stop its progress. When the catarrh is fully developed symptomatic treatment only is necessary. It is well to commence with a mild purgative. Saline diaphoretics suffice during the febrile period. Phenazone or phenacetin may be given every two or three hours to relieve headache and allay any acute congestion of the pharynx and larynx that may be present. Frontal pain calls for nasal inhalation of vapours containing benzoin or conium. The surface-irritation and obstructive swelling may be reduced by cocaine spray (3 per cent. solution), which should be used with caution; or by the use of smelling-salts containing ammonia combined with pine oil, iodine, and carbolic acid.

In infants, in whom the nasal space is proportionately narrower than in the adult, coryza always gives rise to greater difficulty of breathing; and sudden and intense intranasal swelling may lead to attacks of grave dyspnœa with laryngeal spasm, usually during the first few hours of sleep. The best means of quickly reducing the swelling is to pencil the anterior nares with a few drops of cocaine solution (4 per cent.), together with steam inhalations, either plain or medicated. Small doses of bromide of potassium every three or four hours, added to other appropriate general treatment during the acute stage, will reduce the tendency to spasm, especially in rickety children.

2. Chronic Rhinitis.—SYNON.: Chronic Catarrhal Rhinitis; Chronic Coryza; Chronic Rhinorrhœa.

ÆTIOLOGY.—The various influences that induce acute rhinitis may cause the more protracted affection, but there is no clear proof that simple coryza may often lead to intractable catarrh. The stubborn so-called 'colds' of childhood are more often of some specific origin, and are frequently but a symptom of post-nasal adenoid growths.

Local irritants, atmospheric or mechanical, frequently excite and keep up the disease in those more exposed to such influences.

Chronic rhinitis with epistaxis may also be due to excitement or obstruction of the general circulation, as in disease of the heart, liver, or kidneys, as well as in functional derangements of these and other organs, dependent upon irregularities of diet, abuse of stimulants, or neglect of exercise.

There is some evidence to show that the sudden fluctuations of the nasal circulation which occur at puberty, in the menstrual period, during sexual intercourse, or in connexion with pathological conditions of the reproductive organs, may lead to more persistent vascular disturbance, and chronic intranasal congestion.

Anatomical Characters.—The morbid appearances in this affection are of the same character as those met with in acute nasal catarrh, but differ from them in degree and chronicity. Loss of tone occurs in the blood-vessels, with more chronic distension of the erectile tissue, and epithelial thickening as the outcome of an irritation more prolonged. Redness of the mucous membrane is less intense as a rule, and less extensive, but there is more or less constant tumefaction, especially over the turbinated bones. The swelling is soft and yielding; it pits on pressure with a probe, and if cocaine be applied it completely subsides for a time, differing in this respect from hypertrophic rhinitis.

Symptoms.—Persistent irritation, occasional blocking of the nose, and a constant nasal discharge, either thin and watery or mucoid and muco-purulent, are the prominent symptoms. There are also a chronic congestion of the post-nasal space, pharynx, and larynx, accumulation of viscid secretion, sore-throat, hoarseness or cough, and intercurrent deafness. The rhinoscopic appearances just described are more characteristic of this affection than the symptoms.

Treatment.—*See* 3. Hypertrophic Rhinitis.

3. Hypertrophic Rhinitis.—Synon.: Chronic Hypertrophic Nasal Catarrh; Rhinitis Hypertrophica.

Definition.—A further stage of chronic rhinitis characterised by proliferation of the submucous cellular tissue, progressive hypertrophy, thickening of the vascular coats, and dilatation of the vascular sinuses of the erectile bodies of the nasal mucous membrane.

Anatomical Characters.—These can be recognised by means of the rhinoscope, and include irregularly distributed outgrowths, septal deflection, narrowing of the nares, surface-redness (often most intense over the septum), and swelling. Looking from before backwards, the inferior turbinated bodies are first seen as prominent tumefactions blocking the entrance to the inferior meatus. The anterior turbinated hypertrophies are not as a rule symmetrically developed, and the cartilaginous septum is deflected in the direction of least resistance. Hypertrophic changes, affecting the septum itself, give rise to more extended and irregular deviation, with angular projections, spurs, and sometimes dense adhesions with the opposed surfaces; and both nares may be found blocked over different areas and at different levels. Mechanical dilatation (best effected with plugs of cotton-wool soaked in a weak solution of cocaine) is generally requisite to obtain a further rhinoscopic view of the deeper-seated and upper portions. The inferior turbinated tissue will then be found hypertrophied in its whole extent; while erectile tumours also form at the posterior extremity of the bone, pale or dusky red, with uneven surface, blocking up the posterior nares on a level with the lower meatus, and encroaching upon the Eustachian orifices. Ovoid growths on the posterior border of the septum are also met with.

The presenting portions of the middle turbinated bone exhibit a red granulated surface, and the inferior border is bent inwards upon the septum. At a more advanced stage polypi, and cysts of the middle turbinated bone are associated conditions.

Persistent congestion and thickening in the post-nasal space, hypertrophy of the glandular tissue at the pharyngeal vault, chronic follicular pharyngitis, and congestion of the larynx, occur as co-existent and essentially interdependent conditions.

Symptoms.—While in hypertrophic rhinitis, as in the preceding type, surface-irritation, sneezing, nasal discharge, anosmia, headache, pharyngeal irritation, and deafness are the symptoms which constantly occur and interchange during its course, the most characteristic feature is dyspnœa. Obstruction to nasal breathing is present to some extent always, and respiration is very oppressive at intervals from sudden engorgement of the erectile tissue. Any irritation, direct or reflected, may excite these spasmodic suffocative attacks. Fatigue, mental worry, nervous prostration, and all such debilitating conditions, are also active and immediately predisposing influences. The intense blocking of the nose is frequently induced in recumbency, and corresponds generally to the side upon which the patient is lying. The attacks of dyspnœa are therefore very apt to occur at night, and then are a source of much distress. In certain individuals they excite asthmatic seizures and other reflex symptoms—so-called nasal neuroses.

Treatment.—Local measures, to cleanse the surface from irritating secretion, and to control the discharge, are called for in both forms of chronic rhinitis so far described, whether 'simple' or 'hypertrophied.' The nares should be sprayed two or three times a day with alkaline, astringent, and antiseptic lotions, such as a solution of bicarbonate of sodium, borax, and carbolic acid in glycerine and water. 'Listerine' (containing thymc,

eucalyptus, and benzo-boric acid) diluted with water—one part in six—controls fœtor. It may be associated with solution of the chloride of aluminium as an astringent. Chronic indolent swelling of the anterior portion of the inferior turbinated tissue may be reduced by the application of glacial acetic acid on a fine wooden spatula, great care being taken to limit this to the affected part. When these anterior swellings are associated with more active congestion, free scarification of the surface sometimes affords immediate relief and permanent benefit. Glycerine of iodine, or a 10 per cent. solution of chromic acid, is an effectual local remedy for moderate degrees of thickening.

In the more advanced stages of hypertrophic rhinitis, operative treatment may be required.

The treatment of acute intercurrent symptoms is the same as that which has been noticed under Acute Nasal Catarrh.

The general management of each individual case will depend upon those associated constitutional conditions, or special complications, which have been already referred to.

4. **Atrophic Rhinitis.**—Synon.: Rhinitis Atrophica; Dry Nasal Catarrh.

Description.—The special characteristics of this very important affection are dwindling of the soft tissues lining the nasal fossæ and of the underlying bony structures — more particularly the turbinated bones, atrophy of the glands, fatty degeneration of their epithelium, and perverted and essential diminution of the secretion.

The typical rhinoscopic appearances are strikingly wide nares, in which the normal outlines of the turbinated bodies may be almost effaced; an exceptionally free view of the upper pharynx by anterior rhinoscopy; a dry, wrinkled, and pallid surface, with adherent crusts; and accumulated purulent discharge in the upper meatuses and at the vault of the pharynx. Congestion, swelling, and redness may be met with at first, but more often the earliest stage of atrophic rhinitis is associated with a scanty mucopurulent flux. Its course differs markedly from that of chronic rhinitis as usually seen, in which protracted congestion ends in redundancy of tissue, possibly with areas of *localised* contraction. In atrophic rhinitis progressive and *diffuse* wasting is the essential feature; and it is to be regarded as a distinct type rather than merely a terminal phase of prolonged inflammatory processes. Its most important bearing is in association with ozæna.

4a. **Ozæna.**—Synon.: Fr. *Ozène*; Ger. *Stinknase*.

The term 'ozæna' has been applied to every condition of chronic nasal disease in which ulceration is associated with fœtor as a prominent symptom, and ulceration with diseased bone was regarded as the essential element of the disease. 'Ozæna' has thus been used to designate a symptom rather than a disease. So the foul stench accompanying syphilitic disease of the nose—dependent upon caries—is spoken of as syphilitic ozæna. Indeed, syphilis and scrofula have been commonly cited as the chief causes of the affection; in the same way, the fœtid discharge of malignant ulceration of the nose, with necrosis, might be termed 'cancerous ozæna.' Their local signs and course, however, serve to differentiate these symptomatic forms of fœtid rhinitis from the idiopathic affection which we are now considering. This may be defined as a distinct and specific fœtid catarrh, essentially chronic, in which, when it is fully developed, atrophy is the most striking structural change, associated with tenacious purulent discharge, forming greenish-brown adherent crusts, sometimes covering superficial erosions. It is a disease intimately associated with atrophic nasal catarrh, though not absolutely identical with it, unaccompanied by any ulceration or necrosis to account for the odour. This is now generally attributed to the decomposition of retained secretions; it is a fœtor *sui generis*, as distinctive as the greasy smell of suppurating small-pox eruption, and in no way to be confounded with the fœtor of caries. True ozæna in its progress is always associated with intranasal atrophy, but atrophic rhinitis is not invariably fœtid, and the two terms cannot be considered as convertible. The writer has met with typical and even extended wasting of the nares in which there was never any fœtor. The atrophy, however, in these instances developed in adults past middle age. Ozæna dates, as a rule, from childhood or early life. Inflammatory redness and *swelling*, with purulent catarrh, may be the earliest signs in these cases. Fœtor is noted almost from the beginning; wasting is not so evident at the incipient stage, but the tendency to atrophy is soon seen as the disease progresses, and it marks its subsequent course throughout. The affection has been spoken of as 'atrophic rhinitis ending in ozæna;' but there is more reason to regard the disease as of specific nature, and the atrophic degeneration as an associated condition, not the causative one.

More than one micro-organism has been found in the discharge of ozæna, and described as the cause of the odour, and possibly even of the disease. More extended research is, however, required to justify such conclusions.

Symptoms. — The usual symptoms of atrophic rhinitis include irritation arising from deficient lubrication of the mucous membrane, with constant efforts to dislodge the tough and adherent crusts; at times a scanty sanious discharge; a sense of harsh dryness in the nose and throat, with special

sensitiveness of these surfaces to cold, dull aching in the nose, frontal headache, anosmia, and proneness to laryngeal congestion and hoarseness.

In ozæna, which is the more common of the two forms, these symptoms are associated with the characteristic stench which is here the dominant feature.

Treatment.—Thorough cleansing of the nares and post-nasal space is of prime necessity. The several spray solutions recommended for this are mentioned under the treatment of chronic rhinitis. Inunction is one of the best means of relieving the troublesome dryness; lead and mercury ointments serve very well. Sprays of paroleine, applied by special atomisers, act very beneficially, and control fœtor when combined with eucalyptus and menthol. So also does an ointment containing twenty grains of aristol to one ounce of lanolin, rubbed down with a sufficient quantity of almond oil to render it soft. Iodoform is a more powerful antiseptic, but its odour is almost as offensive as that of ozæna. Iodol is less potent, but it has the advantage of being odourless; and as a substitute for iodoform it may be applied by insufflations. Methyl violet in solution or ointment has also been used with advantage in ozæna. Vapour of creasote inhaled through the nose, by means of a specially adapted nasal inhaler, is one of the best local means (supplementing detergent and antiseptic lotions) to overcome fœtor, diminish the formation of crusts, and relieve dryness of the surface.

For the associated general treatment, cod-liver oil, iron, and arsenic are specially indicated.

5. **Affections of the Septum.**—The chief affections of the septum nasi are: (*a*) Acute inflammation; (*b*) Ulceration; (*c*) Abscess; (*d*) Chronic thickening; (*e*) Deviations and spurs; and (*f*) Hæmatoma.

(*a*) *Acute Inflammation.*—This somewhat rare condition is usually the result of the constant inhalation of irritant vapours, especially the vapours of arsenic, mercury, bichromate of potassium, in the manufacture of artificial flowers, wall papers, mirrors, &c.

Though not limited to the septum, it is here that the inflammation is most intense, with epistaxis, ulceration, sloughing, and even perforation. The destruction of tissue, though it may be extensive, is not, however, apt to lead to deformity from shrinking of the tip of the nose, since the front part of the cartilage does not usually suffer.

Like the nasal mucous membrane generally, the septum may also become inflamed in scarlatina, small-pox, measles, diphtheria, and syphilis.

(*b*) *Ulceration.*—Ulceration of the septum occurs in connexion with various inflammatory processes and new-growths, including syphilis and tubercle, lupus, traumatic inflammation, more rarely chronic nasal catarrh, zymotic diseases, and malignant growths.

Syphilitic, lupoid, and tubercular ulcerations are described in other sections.

In scarlatina, measles, and typhoid fever, ulcers are sometimes met with involving the nasal cavities, and more often in glanders and nasal diphtheria. Ulceration has been also observed from gonorrhœal infection of the nasal mucous membrane.

Treatment.—The healing of ulcers is promoted by the application of nitrate of silver, when they are superficial. When they are deeper and persistent, acid nitrate of mercury, or a fine galvano-cautery point carefully applied, is more effectual. The ulcerated surface should be dusted over with iodoform, or covered with an ointment of aristol.

The constitutional treatment will vary with the cause.

(*c*) *Abscess.*—*Acute* abscess of the septum nasi is generally traumatic, but may arise in connexion with infective inflammatory processes, such as erysipelas. It is usually bilateral, and situated in the anterior part of the septum.

The symptoms are those of nasal obstruction, fever, and the usual signs of local inflammation with increased secretion. The external integument is often red, swollen, and tender, and the conjunctiva may also be inflamed. Sometimes vertigo and tinnitus may be observed.

Chronic septal abscess may also be due to injury, or arise from specific causes. It is seen in the anterior region on both sides, and commonly leads to perforation.

Treatment.—Inflammation of the nasal septum, when due to external irritants, usually subsides of itself on the removal of the irritating cause, but such local applications will be called for as alkaline, detergent, and mildly astringent sprays, insufflations of morphine with powdered starch to relieve pain, and evaporating lotions applied on lint over the nose when inflammation is more acute. Together with these local fomentations, general antiphlogistic treatment may sometimes be indicated, but it is not often called for. Abscesses must be opened and drained.

(*d*) *Chronic Thickening.*—This condition of the nasal mucous membrane is usually observed in connexion with hypertrophy, as a result of long-standing chronic catarrh. It is generally confined to the lower and back part of the septum, and is often symmetrical, and associated with similar changes affecting the turbinated bodies.

(*e*) *Deviations and Spurs.*—Perfect symmetry of the nose may be said to be exceptional. The cause of slight deviation of the septum is obscure: possibly extraneous influences involving repeated unilateral pressure, such as sleeping always on one side, or blowing the nose with the same hand.

According to Zuckerkandl the septum is always straight before the seventh year. Injuries and chronic inflammatory processes are the usual causes of extreme deflection. The cartilaginous part of the septum is more often displaced, but frequently the osseous portion also; and both may be simultaneously implicated, producing angular or sigmoid flexures. The back part of the septum is more rarely affected.

Spurs, or bony ridges of the septum, occur alone or in connexion with deviation. The ridge may correspond to the line of junction of the ethmoid and vomer, or to that of the vomer and the crest of the upper maxilla. These outgrowths sometimes attain a considerable size.

Symptoms.— Dyspnœa, impaired voice-sound, deafness arising from associated aural derangements, and protracted nasal catarrh are the frequent and serious results of these deviations of the septum nasi. Spurs produce similar symptoms, which are apt to be most prominent when the two conditions co-exist.

Treatment.—The treatment of deviations and spurs is operative. The general indications are noticed under the head of Hypertrophic Rhinitis.

(*f*) *Hæmatoma.*—Injuries to the nose may be associated with extravasation of blood, and, in exceptional cases, fracture leads to a blood-tumour usually situated upon both sides of the septum. Suppuration is apt to occur in nearly all these cases, followed by perforation of the septum. Hæmatoma may be distinguished from polypus by its symmetrical character, special attachment, and smooth bluish-red surface; from enchondroma by its elasticity, and the absence of hardness.

Treatment. — If the tumour is large, markedly obstructive, with signs of fluctuation, it may be aspirated through a fine cannula, and washed out with an antiseptic fluid. If of more solid consistence, it should be freely incised and the clot turned out. But it is better not to resort to these measures in the earlier stage, or until the symptoms call for active treatment. When applied early, a cooling lotion may be all that is necessary.

6. Diseases of the Accessory Nasal Cavities.—The maxillary, ethmoidal, frontal, and sphenoidal sinuses are subject to morbid changes, sometimes arising primarily, but more often secondarily to affections of the nasal fossæ.

(*a*) *Suppuration.* — These spaces, doubtless, frequently participate in nasal catarrh, and they may completely recover when this passes away. Under certain conditions, however, particularly obstruction or occlusion of their apertures, the catarrhal process may become suppurative and lead to chronic discharge of pus from the nose, or to purulent retention and distension of the cavity or cavities involved.

Ætiology and Pathology.—An inflammatory effusion is most likely to become purulent in the case of the antrum; less so in the frontal sinuses, which, on the other hand, are usually implicated more extensively than the others in simple catarrh (coryza). Inflammation of the maxillary sinus is more frequently due to caries of the molar teeth, with periosteal inflammation and deep-seated suppuration involving the alveolar region. The watery or purulent discharge—simulating nasal catarrh—is then but the overflow from an accumulation in the antrum. Sometimes, however, inflammatory processes originating in the nasal fossæ extend into the antrum. In the earlier stages these may subside with the treatment of the nasal catarrh. Serious consequences may occasionally follow from pressure of a distended sinus upon neighbouring parts, namely, bulging of the eye or cheek, impaired movement of the eyeball, defect or complete loss of vision, changes in and beneath the muco-periosteal lining membrane, periostitis with formation of bony spicules or plates projecting into the cavity, and the formation of a fistula with constant discharge of pus.

Symptoms.—The symptoms of disease of the nasal sinuses depend mainly upon the particular cavity affected. In disease of the antrum, dull heavy pain is felt mainly in the cheek and teeth. When the ethmoidal or sphenoidal sinuses are affected, it is more deep-seated in the region of the orbit. In the frontal sinuses pain resembles a severe frontal headache.

Facial neuralgia may occur in all cases. It is, however, most frequent in affections of the antrum, least so in connexion with the frontal and ethmoidal sinuses. Purulent discharge from the nose is common to disease of all the cavities, unless the aperture into the nasal meatus is occluded, when the pus may find an exit into the orbit or even into the cranial cavity. The flow is generally unilateral in disease of the antrum, and intermittent, occurring especially when the head is bent down; it is more continuous from the other sinuses. In the case of the sphenoidal and more posterior ethmoidal cells it is apt to find its way into the throat; with the frontal and maxillary sinuses diseased it comes forward through the nostrils. The pus is usually without odour, excepting in antral disease, when it is more or less fœtid. Trans-illumination of the maxillary sinuses from the mouth by electric light—originally proposed by Voltolini as a means of more accurately determining the presence of fluid in the antrum—is a valuable aid to diagnosis.

Protrusion of the eyeball may occur in purulent distension of any of the sinuses, but most commonly in ethmoidal disease; it is more rare with effusion into the antrum. Distension of the frontal sinus may cause bulging of the orbital plate. Impaired vision

may be due to pressure upon the optic nerve. The field of vision may be narrowed from antral disease. Sudden and complete loss of sight is an indication of disease of the sphenoidal sinus, and so is ptosis.

(*b*) *Other conditions.*—Apart from simple catarrh and purulent inflammations, the accessory cavities are liable to specific inflammatory processes, such as erysipelas and diphtheria. In the latter, only ecchymosis and œdema are stated to occur, but no false membrane. In erysipelas, head symptoms may supervene with high fever. Mucous and purulent accumulations in the sphenoidal sinuses have been also described in tubercular and cerebro-spinal meningitis. Chronic purulent collections in the same cavities have been accounted a cause of ozæna.

Besides the above-mentioned conditions, neoplasms of various kinds, malignant and non-malignant, develop in the accessory cavities—*e.g.* mucous polypi, cysts, osteomata, fibromata, sarcomata, and epitheliomata. Sometimes they are the seat of thread-worms, maggots, and other parasites. Calcareous degeneration of the lining membrane has been observed in all the sinuses. Mucous polypi are more particularly seen with disease of the ethmoidal cells. Osteomata develop more often in the frontal sinuses.

The symptoms produced by the presence of new-formations in these spaces nearly resemble those caused by purulent accumulations: they are in fact those of distension. Emphysema of the orbit and eyelids has been noticed after blowing the nose, in association with defects in the orbital plate of the ethmoid, as well as from fractures through the ethmoidal cells.

Treatment.—In most cases the treatment of the different forms of rhinitis suffices to reduce acute obstructive swelling, to relieve tension and pain, and control discharge. Other obstructing causes, such as thickening, outgrowth, or polypus, must be removed, or dilatation of the narrowed passages may be effected with a probe. In more aggravated cases, where there is retention of pus in a frontal sinus with urgent symptoms, the cavity must be opened from without by surgical methods. Blocking of the antral orifice may occur from extension of inflammation, from the sinus being plugged with viscid discharge, new-growth, or diffuse thickening in the nose.

An accumulation of pus in the antrum, whatever its source, must be evacuated, and free drainage established. The usual and best way to effect this is by extracting one of the upper teeth, and making an opening into the antrum through the alveolar socket, extracting a diseased tooth if one be found. In some cases it may be better to make the opening in the canine fossa. If the flow of pus is still impeded, the source of obstruction must be sought for and removed. The cavity is then to be washed out with an antiseptic fluid; and sometimes, in order to do this thoroughly, it may be necessary to make a counter-opening in the nasal fossa over the antral orifice. To prevent premature closing of the alveolar opening, a silver cannula should be fitted into it, and kept in place by means of a properly adjusted plate. The subsequent treatment consists in the patient himself daily syringing out the cavity with a warm aqueous solution of carbolic or boric acid. Tincture of iodine diluted with water, or a weak solution of iodated zinc, is better adapted to a later stage.

7. **Syphilis.**—(*a*) *Primary syphilis* may attack the nose by direct inoculation. It is generally seen at or just within the orifice of the nostril. In most cases a nasal chancre is the result of the inoculation of moist secondary lesions, the virus being conveyed generally by the finger, as in nurses attending syphilitic infants. Chancres of the external surface may also occur; originating from wounds such as bites. Chancre is generally single; and appears either as a papule or tubercle with ulcerated summit, or as a more flat erosion. Its specific characters are a circumscribed ulcer with indurated base and borders, accompanied by enlargement of the neighbouring lymphatic glands, headache, lassitude, and sometimes slight rise of temperature. More commonly the lesions met with in syphilitic rhinitis, acquired or congenital, are those associated with general constitutional infection, namely, catarrh of the mucous membrane, specific eruptions, infiltration of the deeper layers with diffuse hyperplasia, circumscribed gummatous growth leading to abscess, disease of the cartilage, periostitis, caries, and necrosis.

(*b*) Mere *congestion*, with swelling of the pituitary membrane and discharge, occurring in the earlier course of acquired syphilis, has nothing to distinguish it from simple nasal catarrh. As a rule, the symptoms are less intense than those of acute coryza. Unless aggravated by extraneous causes, they only tend to irritation and soreness; and neither chronicity nor the character of the discharge offers any reliable aid in diagnosis. This can be established only by the co-existence of more definite general signs of syphilis elsewhere. Intense and persistent nasal obstruction is a very marked feature at the outset of congenital syphilis. It has occasionally to be diagnosed from post-nasal growths.

(*c*) *Mucous patches* of the nose are usually seated about the nostrils, involving the contiguous mucous and cutaneous surfaces. In this region they are often more fissured than papular, with scanty secretion, or covered with thin scales. On the intranasal surface they are more papular in their early stage. They appear either as slightly raised circum-

scribed erosions, or as superficial ulcers, on the anterior part of the septum or over the inferior turbinated bodies. They are more frequent in infantile syphilis, though they readily escape detection, being hidden by the swelling and discharge.

(*d*) The onset of so-called *tertiary manifestations* is characterised by perforating ulceration of the mucosa, with cellulitis and infiltration of the submucous tissue. Ulcers, either single or, when multiple, coalescing and spreading, with livid swollen borders, undermined edges, and yellowish-grey surface; deep dusky redness, with diffuse and brawny swelling of the septum, bathed in muco-purulent secretion, are the rhinoscopic appearances at this period. Burrowing sinuses —generally seated along the septum—with discharge of fœtid pus, are later evidences of further extension to cartilage and bone, which, ending in necrosis and exfoliation, leads to deformity.

These usually proceed from caries of the vomer or the nasal bones. Disease of the cartilaginous portion may terminate in limited perforation if quickly arrested, and leave little inconvenience or disfiguration. Total destruction of the septal cartilage results in characteristic flattening of the tip of the nose; but caries and necrosis of the vomer are now rarely absent. These may again be limited, or extend in different directions, and so end in grave losses of substance, the bridge of the nose falling in, and perforation of the floor establishing a communication with the mouth.

With superficial inflammation and ulceration only, the earlier symptoms are those of chronic nasal catarrh. Fœtid discharge, deep-seated pain, and intranasal obstruction, together with distressing headache, and, not infrequently, severe attacks of otitis, mark the course of the deeper lesions.

Livid redness and boggy tumefaction of the outer surface, especially seen over the bridge of the nose and extending to the orbital region, indicate retention of pus, which may give rise to intractable fistulæ. At the same time the skin itself often presents ulcerating syphilides.

Deep ulceration of the pharynx and post-nasal space, and in many cases of the larynx, accompanies, almost as a rule, the advanced period of nasal syphilis.

With loss of the velum there is regurgitation of liquids in swallowing, and snuffling speech.

Treatment.—In addition to the established methods of treatment with mercury and iodide of potassium in the respective stages, several special points have to be considered. The superficial lesions of the pituitary membrane require little local treatment. Solid nitrate of silver, a solution of sulphate of copper, and acid nitrate of mercury are the best applications.

In syphilitic coryza of infants mercurial frictions should be used, with the local remedies indicated under the head of Acute Nasal Catarrh.

Later lesions demand more active local measures. In the most threatening cases, however, destructive processes may be averted by large doses of iodide of potassium and mercury. Abscesses must be promptly incised, sinuses laid open, and superficial caries scraped away. This should be followed by insufflations of iodoform. Loose dead bone is to be removed. Cleansing and antiseptic lotions, such as have been enumerated, should be freely used in the form of spray, or vapour of creasote or carbolic acid inhaled through the nose to control fœtid discharge.

The marked tendency to contraction of tissue in syphilis is a serious obstacle in overcoming naso-pharyngeal webs. The writer has found the most inveterate cases in the inherited disease. Operative measures for their permanent removal mostly fail.

8. **Lupus and Tuberculosis.**—Lupus affecting the external aspect of the nose is fully described in the articles Lupus Erythematosus; and Lupus Vulgaris. When lupus spreads to the nasal fossæ the septal cartilage may be perforated or destroyed. Extension to the bony septum is very rare.

Anatomical Characters.—Primary lupus of the pituitary membrane is less common. The tubercles and ulcers form more often on the septum. Greyish-red tumours, the size of a pea or a small nut, break down and form ulcers, with sharply cut or undermined edges, densely infiltrated bases, and granular greyish-white surface. Ulceration alone is the prominent feature in other cases. The inferior turbinated surface, and sometimes the floor of the nasal fossæ, are also affected.

Diagnosis.—Lupus of the nose has to be carefully distinguished from syphilis. This may be done by bearing in mind that lupus develops in early life, and is specially limited to that period; that syphilitic tubercles are, as a rule, larger, more dense and hard, and progress more rapidly to ulceration, the ulcerated surface becoming covered with thick greenish crusts; and that tubercular and pustulo-crustaceous syphilides, respectively, are found on other parts of the body in association with the nasal affection. Beyond this, the history of the case and the effect of antisyphilitic treatment will decide the question in doubtful instances.

Treatment.—To destroy the neoplasm of lupus, the galvano-cautery, scraping, or the application of caustic pastes may be employed. One containing chloride of zinc is very effectual. Inflammation is best allayed by applying sedative lotions before the use of escharotics; mildly astringent and antiseptic washes in the after-treatment promote healing of the cauterised surface.

Lactic acid, menthol, iodoform, and iodol

are the best local applications to tubercular ulcerations of the nasal fossæ. General treatment by means of cod-liver oil and tonics is called for in both of these affections.

9. **Rhinoscleroma.**—Ætiology. — This affection is of extremely rare occurrence. It has been observed more especially in Austria and Italy, and is said to be less infrequent in Central America. Its cause is unknown.

Description.—The disease is characterised by nodulated induration of the skin and mucous membrane, commencing over the upper lip and at the orifices of the nostrils in the form of sharply defined, prominent, and hard patches, tender but otherwise painless, with smooth or shining surface, varying in hue from the normal colour of the skin to a dusky redness. The growths are incorporated with the skin, which is deeply infiltrated. They do not become generalised beyond the parts primarily affected; neither is there inflammation with swelling of the surrounding surface. There may be superficial excoriation with scabbing, but never any ulceration or loss of substance, nor interstitial shrinking. This serves to distinguish the affection from lupus, malignant disease, and tubercular syphilides. It resists antisyphilitic treatment. It somewhat resembles keloid, but there is no preceding scarring. Progressing, it invades the nasal septum, and the mucous membrane of the nasal fossæ, and thence may extend to the pharynx and larynx, the gums, and the buccal mucous membrane. The course is chronic; it may extend over fifteen or twenty years.

When fully developed, its characteristic features are ivory-like hardness, with brawny thickening and rigidity of the skin over the nose and upper lip, deformity, thickening of the septum, blocking of the nasal passages, and sometimes urgent dyspnœa from laryngeal stenosis. The affection is strikingly indolent, showing no fatal tendency nor even any general constitutional disturbance. Organisms have been described in the affected parts. *See* Micro-organisms: 13.

The majority of the cases occur between the ages of twenty and forty-five, and no special exciting or predisposing condition has been noted.

Prognosis.—The prognosis, so far as cure is concerned, is most unfavourable.

Treatment.—Tho troatment of rhinoscleroma can only be palliative.

10. **Diphtheria.** — Diphtheria affecting the nasal passages is more rarely met with as a primary local manifestation than as an extension from the pharynx. Mucoid and muco-purulent discharge from the nose, tinged with blood, often fœtid and mixed with shreds of membrane, together with blocking of the nose, aro the local symptoms. *See* Diphtheria.

11. **Glanders.**—*See* Glanders.

12. **Foreign Bodies in the Nose.**—Buttons, pieces of pencil, or other small bodies are sometimes introduced into, and become firmly fixed in, the nasal cavities by children or hysterical women; occasionally, too, they have been ejected into the back part of the nose by vomiting, having been swallowed. The commonest situation for a foreign body in the nose is against the anterior portion of the inferior turbinated body; in the back part of the nose they are usually found in the lower meatus. Their presence generally induces, after a time, an offensive muco-purulent, sometimes sanguineous, discharge. Ulceration, and even perforation, of the septum may result, but necrosis has not been observed.

Rhinoliths. — Calculous concretions are occasionally found in the nares. They originate in a deposit of the saline constituents of the nasal mucus. The concretions are made up chiefly of phosphate and carbonate of calcium, with about 20 per cent. of organic matter, and, as a rule, are probably referable to some alteration in the character of the nasal secretion. The symptoms are those of a foreign body long retained—increasing pressure from progressive accretion of the deposit, ulceration, profuse purulent discharge from the nostrils or into the throat, often offensive, in exceptional cases even burrowing outwards through a fistulous opening on the face. Neuralgia is sometimes also caused by the presence of these substances. In other cases the symptoms may be only those of chronic nasal catarrh with obstruction. The writer once met with a case in a young woman suffering from chronic hypertrophic rhinitis associated with mucous polypi. During removal of the growths a calcareous substance was found wedged in the lower portion of the middle meatus, and deeply imbedded in the polypous mass. This proved upon extraction to be a rhinolith, the nucleus of which was half of a large bead.

13. **Parasites in the Nasal Cavities.**—Parasites occasionally infest the nose, and may produce very serious symptoms. They are specially met with in hot climates; in the temperate zone they are of very rare occurrence.

The most common form seen are *maggots*, derived from the ova of different kinds of flies deposited in the nasal passages or accessory nasal cavities. They are there quickly hatched, and may make their way into all the spaces of this region, destroying the lining membrane, and sometimes causing necrosis of the osseous walls. In extreme cases the larvæ may burrow into the connectivo tissue of the faco and scalp, producing extensive destruction of tho tissues.

Earwigs, *leeches*, the *larvæ of beetles*, *round-worms*, and *thread-worms* occasionally invade the nasal passages.

Treatment.—Chloroform has been found the most efficacious means for destroying these parasites.

14. **Tumours.**—(*a*) *Mucous Polypus.*—This is the most common of all intranasal tumours. It is in many instances associated with hypertrophic rhinitis, and appears to result from continued catarrhal irritation.

Anatomical Characters.—Mucous polypi consist of a reticulum of connective tissue, enclosing in interspaces a muco-gelatinous fluid which contains round and fusiform cells. As a rule they are multiple, often bilateral, and in clusters, the tumours varying much in size. They may readily be recognised by their greyish-coloured surface traversed by dilated blood-vessels, their soft and gelatinous consistence, their mobility, and their fluctuating size, due to their hygrometric property.

Mucous polypi are attached by narrow pedicles, more or less dense, and they more commonly spring from the middle turbinated bodies, but have sometimes deeper attachments, such as the superior turbinated bones and upper meatus, the infundibulum, and the borders of the hiatus semilunaris. They usually grow forwards, and occupy the anterior portion of the nasal fossæ. They may also hang into and block the post-nasal space.

Symptoms.—The ordinary symptoms of polypus of the nose are nasal obstruction with dyspnœa, aggravated in damp weather, muffled voice-sound, a sense of 'fulness of the head' and oppression with headache, nasal irritation and sneezing, impairment or total loss of smell, and mouth-breathing, with dryness and irritation of the throat. In certain individuals mucous polypi are an exciting cause of asthmatic attacks.

Treatment.—Removal of the growths is the only effectual treatment. The wire snare is beyond question the best instrument to operate with. A cold wire generally answers better in the case of the large polypi. A galvano-cautery loop is preferable for the removal of smaller growths and redundant tissue. The base of the polypi must be destroyed by the galvano-cautery or chromic acid to prevent recurrence, and it is essential that the last trace of growths should be removed. To effect this, the nasal fossæ must be thoroughly explored, and all operative measures carried out under a bright light through a nasal speculum.

(*b*) *Fibroma of the Post-nasal and Nasal Region.* — *Naso-pharyngeal Polypus.* — Synon.: Nasal Fibroma.—This is a more rare growth, mainly of surgical interest, occurring between fifteen and twenty-five, and more common in males.

It is a hard, fibroid, rounded and lobulated, very vascular tumour, growing from the periosteum covering the basilar process of the occipital bone, at the vault of the pharynx, or from the body of the sphenoid, or in the upper and posterior part of the nasal cavity itself.

Fibromata may become so large as to encroach upon, displace, and destroy the neighbouring structures, expand the osseous framework of the nose, and give rise to that peculiar type of facial distortion known as 'frog-face.' Sometimes they lead to bulging of the palate and deformity of the mouth, or, tending upwards and outwards, cause protrusion of the eyeballs. Invasion of the cranial cavity through the cribriform plate of the ethmoid or of the sphenoidal cells may occur as an extreme result.

The chief symptoms of naso-pharyngeal polypus are nasal obstruction, tenacious mucous or muco-purulent discharge frequently tinged with blood, impairment of the voice, dyspnœa, anosmia, deafness, headache and facial neuralgia, somnolence, difficulty in swallowing, regurgitation of liquids into the nose, and epistaxis. Sarcomatous degeneration is not uncommon. The growth may also have a mixed character from the beginning, and present the type of myxo-fibroma, adeno-fibroma, chondro-fibroma, or osteo-fibroma, chiefly occurring in the nose proper.

Treatment.—This kind of growth, when circumscribed, should be removed with a wire snare, preferably cold to prevent hæmorrhage, which is the immediate danger in extirpating the growth. Electrolysis has in several instances effected a very marked reduction in the tumour.

For more severe cases surgical interference on a larger scale is called for.

(*c*) *Papillomata.*—These wart-like growths are usually met with on the anterior portion of the inferior turbinated bodies, on the septum—at the junction of the cartilaginous and osseous portion, and on the floor of the nose. More rarely, they spring from the mucous membrane lining the deeper portions of the nasal fossæ as well.

The symptoms are obstruction, surface-irritation, discharge, and epistaxis. The treatment consists in evulsion by cutting forceps, or snare; or destruction by the galvano-cautery.

(*d*) *Ecchondromata.* — Cartilaginous outgrowths are not uncommon in the nose, associated with septal deflection. They may be recognised as convex protuberances with broad base, springing from the cartilaginous septum, and producing either obstruction or complete occlusion of the nasal passage. Independently of septal deviations, cartilaginous tumours are rare; they originate in the cartilaginous septum, the outer wall of the nose, or even the vault of the pharynx. They appear as dense, spheroidal tumours, which in extreme cases may attain very large dimensions, and then resemble naso-pharyngeal fibromata in their course and symptoms. When smaller, ecchondromata

in the anterior part of the nares cause only obstructive and catarrhal symptoms.

Treatment. — Cartilaginous outgrowths from the septum should either be removed with the galvano-cautery knife or a nasal saw, or they may be snared off when they are more distinctly pedunculated. Deep-seated destructive tumours call for more elaborate operation.

(*e*) *Exostoses.*—Osseous outgrowths, forming bony spurs or bridges obstructing the nares, have already been described.

(*f*) *Osteomata.*—These growths, of varying size and hardness, are more or less spherical, and covered by deep red mucous membrane. They are generally met with between the ages of twenty and twenty-five. They differ from exostoses in that they are not attached to the osseous walls of the nose.

The symptoms that they give rise to often resemble those produced by foreign bodies, or rhinoliths, including neuralgia, headache, soreness and intense itching of the nose, discharge—which may be fœtid from ulceration and necrosis, anosmia, and epistaxis. The treatment involves operation.

(*g*) *Angeiomata.*—These vascular growths, the so-called 'erectile tumours,' are very rare. They are accompanied by catarrh, and particularly by hæmorrhage. They appear as bluish-red or deep purple elevations of the mucous membrane, with irregularly mammillated surface, at times distinctly pulsating. Obliteration of the growth with the galvano-cautery is the best treatment.

(*h*) *Malignant growths: Sarcoma—Carcinoma.*—Malignant disease of the nasal fossæ is rare — carcinoma more rare than sarcoma. The tumour is a single pedunculated growth, with a broad base, dark red or bluish, and less dense than nasal fibroma, but more widespread in the post-nasal region, presenting a rounded and lobulated surface. The ætiology is obscure. The growth has been ascribed to irritation of nasal polypi, but on insufficient evidence.

Sarcoma, as a complication of nasal fibroma, has already been referred to.

Cancer of this region may be a direct extension from the pharynx or antrum; or it may occur as a secondary manifestation, and then present the type of scirrhus or encephaloid.

Epithelioma is moro common. Beginning as a wart-like excrescence on the scptum or alæ, it grows rapidly, invadcs the surrounding tissucs, and results in deep spreading infiltration and ulceration. The symptoms are those already described as produced by all invading growths of this rogion, associated with progressivo impairment of health and cachexia.

Treatment.—Temporary benefit can bo obtained by operation. Palliative measurcs, to relieve pain and to meet any urgent symptoms that may arise, are, as a rule, the only treatment that can be adoptcd with advantago. In nasal sarcoma cure is sometimes effected by early rcmoval of the growth.

15. **Post-nasal Adenoid Growths.**—Ætiology.—The great majority of cases are met with in childhood. At timcs one is called upon to treat the disease in adults, but this is exceptional; and when post-nasal growths are found in any marked degree of development between the ages of twenty and twenty-five, the clinical history will show that the characteristic symptoms of the affection had been evident from a much earlier age. The influence of heredity is often striking. These growths are said to occur especially in subjects of a lymphatic temperament or strumous diathesis. There is, however, no evidence that the vegetations are essentially related to any specific disease. They occur in all classes, under the most varied conditions of living. They may therefore be said to arise solely from a catarrhal process, the tendency to which is inherited, and which induces overgrowth of the adenoid tissue of the post-nasal space; and to constitute an early hypertrophic disease of the naso-pharyngeal tract, which in later life may sometimes result in chronic hypertrophic rhinitis.

The tendency to active growth of lymphoid tissue in childhood appears to be the main predisposing factor in the production of the disease. The exciting causes are all the influences which promote naso-pharyngeal inflammation, including a cold and damp atmosphere, scarlet fever, measles, and whooping-cough. The condition is in a certain proportion of cases associated with cleft palate. In many cases no special cause can be found.

Anatomical Characters. — The growth occurs as an aggregated mass at the vault of the pharynx. With the rhinoscope it is there seen as a circumscribed outgrowth, with a lobulated and fissured surface, situated centrally at the uppermost portion of the naso-pharyngeal cavity. It is analogous in appearance to the faucial tonsils, and is known as the *pharyngeal* or *Luschka's tonsil*. The growths over the lower and lateral portions of the post-nasal surface are more disseminated. When they attain a large size, they project downwards and forwards from the pharyngcal roof, invading and blocking the posterior nares. Extending also laterally, the vegetations encroach upon the Eustachian orifices and obstruct them more or less.

Symptoms.—These vary according to the localisation and extent of the overgrowth in individual cascs. The characteristic symptoms are obstinato nasal catarrh, the discharge being watery, mucous, or at times bloody; heavy stertorous breathing; inability to keep the mouth closed; mufiled, thick speech, associated with a peculiar 'deadness'

of voice; deafness, which, when occurring in early childhood, may at times even result in deaf-mutism; and a vacant facial expression, coupled in aggravated cases with dulness of intellect. Relapsing bronchitis is a not uncommon associate of post-nasal growths, and some cases of asthma in children are either directly due to these or aggravated by their presence. The interference with respiration may prevent development of the thorax, and lead to serious retraction or even deformity of the chest. Post-nasal adenoid growths are a very important source of reflex irritation in certain cases of periodically recurrent and spasmodic coryza, identical in every way with so-called 'hay fever.' In very young infants the obstruction to breathing may be so great as to interfere very seriously with nutrition.

Course.—The active stage of development commences sometimes in very early infancy, and it continues to the age of puberty. After this period the progress of the growths is often arrested; they diminish gradually in size; and in their withered condition they cease to encroach upon the now more roomy post-nasal space.

Diagnosis.—The features of this disease are, as a rule, sufficiently diagnostic. The existence of the growths can be determined by examination with the rhinoscopic mirror or exploration of the post-nasal cavity with the finger. In very young subjects the latter is the readier and more feasible method. The growths are more or less soft. When large, they feel like a mass of earth-worms; when smaller and more diffuse, their surface is granular and velvety. They are very vascular; and they bleed readily, at times very freely, even on introduction of the finger for the purpose of examination.

Treatment.—A cure can only be obtained by extirpation of the growths. The operation must be performed without delay. Evulsion of the growths is best effected by cutting forceps; in other instances they may be scraped away with specially devised ring-shaped knives. The general health requires attention.

William Mac Neill Whistler.

NOSOPHYTA (νόσος, a disease; and φυτόν, a plant).—A term employed by Gruby to designate a group of cutaneous affections, in which a fungus-formation constitutes an essential part of the disease. *See* Tinea Tonsurans; Tinea Versicolor; and Favus.

NOSTALGIA (νόστος, return; and ἄλγος, sadness).—Synon.: Fr. *Nostalgie*; Ger. *Heimweh*.—A form of melancholia, sometimes occurring in persons who have left their homes. The symptom from which it derives its name is an intense desire to return home; and this is accompanied by great mental and physical depression, which may end fatally. *See* Melancholia.

NUCLEUS.—*See* Cell.

NUMMULATED SPUTUM (*nummus*, a coin).—A form of sputum which, when spreading out on a surface or floating in water, resembles a coin in shape. *See* Expectoration; and Sputum, Examination of.

NURSES, Training of.—Training is to teach not only what is to be done, but how to do it. The physician or surgeon orders what is to be done. Training has to teach the nurse how to do it to his order; and to teach, not only how to do it, but *why* such and such a thing is done, and not such and such another; as also to teach symptoms, and what symptoms indicate what of disease or change, and the 'reason why' of such symptoms.

Nearly all physicians' orders are conditional. Telling the nurse what to do is not enough and cannot be enough to perfect her — whatever her surroundings. The trained power of attending to one's own impressions made by one's own senses, so that these should *tell* the nurse how the patient is, is the *sine quâ non* of being a nurse at all. The nurse's eye and ear must be trained—smell and touch are her two right hands—and her taste is sometimes as necessary to the nurse as her head. Observation may always be improved by training—will indeed seldom be found without training; for otherwise the nurse does not know what to look for. Merely looking at the sick is not observing. To look is not always to see. It needs a high degree of training to look, so that looking shall tell the nurse aright, so that she may tell the medical officer aright what has happened in his absence—a higher degree in medical than in surgical cases, because the wound may tell its own tale in some respects; but highest of all, of course, in children's cases, because the child cannot tell its own tale; it cannot always answer questions. A conscientious nurse is not necessarily an observing nurse; and life or death may lie with the good observer. Without a trained power of observation, no nurse can be of any use in reporting to the medical attendant. The best one can hope for is that he will be clever enough not to mind her, as is so often the case. Without a trained power of observation, neither can the nurse obey intelligently his directions. It is most important to observe the symptoms of illness; it is, if possible, more important still to observe the symptoms of nursing; of what is the fault not of the illness, but of the nursing. Observation tells *how* the patient is; reflection tells *what* is to be done; training tells *how* it is to be done. Training and experience are, of course, necessary to teach us, too, *how* to observe, *what* to observe; *how* to think, *what* to think. Observation tells us the fact; reflection the meaning of the fact. Reflection needs training as much

as observation. Otherwise the untrained nurse, like other people called quacks, easily falls into the confusion of '*on account of*,' because '*after*'—the blunder of the 'three crows.' The nurse is told by the medical attendant, 'If such or such a change occur, or if such or such symptoms appear, you are to do so and so, or to vary my treatment in such or such a manner.' In no case is the physician or surgeon always there. The woman must have trained powers of observation and reflection, or she cannot obey. The patient's life is lost by her blunder, or 'sequelæ' of incurable infirmity make after-life a long disease; and people say, 'The doctor is to blame;' or, worse still, they talk of it as if God were to blame—as if it were God's will. God's will is *not* that we should leave our nurses, in whose hands we must leave issues of life or death, without training to fulfil the responsibilities of such momentous issues.

To obey *is* to understand orders, and to understand orders really is to obey. A nurse does not know how to do what she is told without such 'training' as enables her to understand what she is told; or without such moral and disciplinary 'training' as enables her to give her whole self to obey. A woman cannot be a good and intelligent nurse without being a good and intelligent woman. Therefore, what 'training' signifies in the wide sense, what makes a *good training-school*, what moral and disciplinary 'training' means, and how it is to be attained, are to be clearly understood.

The essentials for a training-school (or, indeed, for a nurse-establishment of any kind) may be shortly given thus:—

(*a*) That nurses should be technically trained in hospitals *organised for the purpose*.

(*b*) That they should live in 'homes' fit to form their moral lives and discipline, to which may be added:—

I. *What makes a good Training-school for Nurses?*

(1) At least a year's practical and technical *training* in hospital wards, under *trained* head-nurses (so-called 'sisters' of London hospitals), who themselves have been *trained* to *train*. A second year if possible as ward-nurse (day and night), with the benefit of further theoretical instruction.

For a district nurse, at least an additional three months' training in nursing by the poor bedside, under a trained and training district superintendent, is essential.

The training of probationers should be as much a part of the duty of the head-nurse ('sister') as directing the under-nurses or seeing to the patients.

To tell the training, you require weekly records, under printed heads corresponding with the 'List of Duties,' kept by the head-nurses, of the progress of each probationer (pupil) in her ward-work, and in the moral qualities necessary in her ward-work; a monthly record by the matron of the results of the weekly records; and a quarterly statement by her as to how each head-nurse has performed her duty to each probationer. The whole to be examined periodically by the governing body.

(2) Clinical lectures from the hospital professors; lectures on subjects connected with nurses' special duties, such as elementary instruction in chemistry, with reference to air, water, food, &c.; physiology, with reference to a knowledge of the leading functions of the body; and general instruction on medical and surgical topics; examinations, written and oral, at least four of each in the year, all adapted to nurses; as also lectures and demonstrations with anatomical, chemical, and other illustrations, adapted especially to nurses—all in the presence and under the care of the matron (Lady Superintendent) and mistress of probationers (Class-mistress and 'Home'-sister); together with instruction from a medical instructor, one of the hospital professors and hospital medical staff, specially selected to teach the nurses.

A good nurses' library of professional books, not for the probationers to skip and dip in at random, but to be made careful use of, under the medical instructor and class-mistress.

(3) Classes for a competent mistress to drill the professorial teaching into the probationers' minds; the mistress of probationers to be above all a 'home'-sister, capable of making the 'home' a real *home*, and of training and disciplining the probationers there in all good—in moral qualities, customs and habits, and manners, without which no woman can be a nurse, and in their duty and feeling to God as well as to their neighbour.

(4) The authority and discipline over all the women of a trained lady-superintendent, who is also matron of the hospital, and who is herself the best nurse in the hospital, the example and leader of her nurses in all that she wishes her nurses to be, in all that training is to make her nurses.

(5) An organisation not only to give this training systematically, and to test it by current tests and examinations, but also to give the probationers, by proper help in the wards, time to do their work as pupils as well as assistant-nurses, and above all to make it a real moral as well as nursing probation—for nursing is a probation as well as a mission.

(6) Accommodation for sleeping, classes, and meals; arrangements for time and teaching and work; surroundings of a moral and religious, and hard-working and sober, yet cheerful tone and atmosphere, such as to make the training-school and hospital a 'home' which no good young woman of any class need fear by entering to lose anything of health of body or mind; with moral and

spiritual helps, and an elevating and motherly influence over all, such as to make the whole a place which will train really good women, who can withstand temptation and do real work, and neither be 'romantic' nor 'menial.' For, make a hospital as good as you will, hospital-nurses require more such helps, and get less, than women either in their own homes or in domestic service.

Every hospital should have and *be* such a school for training nurses for itself and other institutions, including district and private nurses, who must be trained in hospitals, and therefore cannot have a training-school of their own. Professors and medical staff cannot be always, or indeed ever at hospital bedsides, showing nurses what to do. Let them give the pupil-nurses clinical and other lectures. Above all, this is necessary for those who are to be head-nurses, matrons, and lady-superintendents. The success of any training-school depends mainly upon having trained nurses themselves capable of training others—(*a*) in ward-nursing; and (*b*) in cases, so as to be able to understand what physician and surgeon order, and do it.

II. *Course for all Probationers.*

(1) To do duty as assistant-nurse and probationer successively in one or more wards of each of the hospital divisions, one or two or three months in each, male and female surgical, male and female medical, children's, obstetric, ophthalmic, Magdalen; ending her course, if possible, in the medical instructor's wards.

The course should, if possible, *begin* in the female medical wards. No two *fresh* probationers to be in the same ward. One nurse-probationer and one lady-probationer to be together, where possible.

(2) To learn ward-management by being in charge of wards during the head-nurse's dinner-hour, and during nurses' recreation hours; to take, when sufficiently advanced in the year's training, day or night staff duty for staff-nurses on their holidays; to have at least one month's night duty—a fortnight at a time—in the year's training.

(3) To take, when sufficiently advanced, special duty, by day or by night, upon special cases, such as ovariotomy, lithotomy, tracheotomy, typhoid, &c., in the single-bed wards.

(4) To make a set of all the different bandages required.

(5) To learn from the head-nurse to read the 'cards,' or patients' bed-tickets, especially in the medical wards.

(6) To keep a diary of her ward duties.

Besides this diary, each probationer at least once a month to draw up a sketch of her day's work, not merely as a ward-assistant or assistant-nurse, but as a probationer in training, namely, what she has learnt that day from ward-sister and staff-nurse, what she has observed on special cases in the ward, &c.

Warning is given out only *after* the day's work, that it is such and such probationer's day to write it out.

(7) To take careful notes of cases. A case-paper should be regularly kept by every probationer of cases selected by the medical instructor.

The case-paper to have printed headings, such as 'Temperature,' 'Pulse,' 'Respiration,' to be taken morning and evening [in some cases the physician will require the 'temperature' to be taken as often as every hour, or even every quarter of an hour], 'Sleep,' 'Nourishment,' 'Urine,' 'Stools,' to be noted every twenty-four hours—in each case character as well as quantity; 'Treatment,' to be noted daily, in English, and not copied off the 'cards'; and other such heads; preceded by a real medical history of the case—of the causation of the disease; for example, in typhoid fever and other dirt-diseases, produced by foul air and foul water. This is followed by remarks on the termination of the case. These case-papers should be rigorously overhauled by ward-sisters and the class-mistress, as well as by the medical instructor, who should also at his own hospital-beds check the case-taking.

(8) To take careful notes of all lectures, also overlooked by class-mistress and medical instructor.

(9) To read and be shown illustrations of the cases nursed in the wards [the keen professional interest felt by a promising probationer in finding her own cases in a book must be encouraged].

(10) To jot down afterwards, but while still fresh in the memory, any remarks suitable for her own instruction made to the students by the hospital physicians and surgeons in going their rounds, and to write out her jottings in the class-room under the superintendence of the 'home'-sister.

(11) To write out under the superintendence of the 'home'-sister what has been learnt both from ward-sisters and medical instructor as to what is to be done and how to do it in nursing; as to *why* it is done, and why something else is not done; as to symptoms and the 'reason why' of such symptoms.

Without (*a*) time for these things, average nurse-probationers degenerate into conceited ward-drudges. Without (*b*) a system for these things, they potter and cobble out their year about the patients, and make not much progress in real nursing—that is, in obeying the physicians' and surgeons' orders intelligently and perfectly.

III. *Training to Train.*—To enable nurses to train nurses, a special training is required; and for this a longer period than a year, or even two years, in the hospital is necessary. To *train* to *train* needs a system:—

(1) A systematic course of reading, laid down by the medical instructor, who recommends the books for the training-school

library. Hours of study, say two afternoons a week; class-mistress ('home'-sister) to lead one at least of these afternoons.

(2) Regular oral examinations by medical instructor; each training-nurse must acquire powers of expression to train others. He must cultivate these in answering him. Some system of mutual examination.

(3) At least four written examinations in the year on written questions, by the medical instructor. Essays to be written on given subjects in nursing.

(4) Pre-eminently careful notes of lectures, in order to enable nurses in future to drill others in understanding the professional lectures, as they have themselves been drilled.

(5) Pre-eminently careful notes of cases—the touchstone for the future trainer. If she cannot observe and understand her own cases, how can she teach others to observe and understand them? If she never learn the reason of what is done, how can she train others to learn it? 'Reading up' her own cases.

(6) A current constant course of careful learning from head-nurses and medical instructor and physicians or surgeons in wards where she is probationer, to know not only what symptoms are there, and what symptoms are to be expected in such and such an event, but also the *meaning* of such symptoms—the 'reason why.' To know not only when a wound or surgical injury or operation 'looks well' and when it 'looks ill,' but *why* it looks well or ill; and to be able to tell others *why*. To know not only what is to be done, and how it is to be done, but *why that* is done, and not something else.

(7) At least twice in the year's training, but not at the beginning, to have a week or more of going the night-rounds with the night-superintendent of nurses, which is equally good for night-superintendent and for probationer. The future ward 'sister' or matron should have had at least three months as night staff-nurse under an experienced night-nurse, to teach her what the responsibilities of a hospital-ward night-nurse are.

(8) To spend at least a week, but not at the beginning of her year, in the linenry.

(9) The future superintendent, who is to have a training school, should have *at least* a fortnight in the year, about six or nine months on in her training, in the 'home' if possible, taking or assisting at classes, and doing all but the 'home'-sister's secretarial work.

(10) Taking temporary duty of ward-sisters on their holidays, and—the best—of 'home'-sister on her holiday. Of course no fresh probationer, however gifted, would be put on such duty.

(11) Being relieved of the more menial ward-work, such as cleaning lavatory basins, w.c. pans, &c., when she can do it so perfectly of herself without being told, that she can teach others to do it. This will scarcely be, for all kinds of this ward-work, before she is a six months' old probationer.

(12) A second or third year's training for the higher posts. A future matron or lady-superintendent to have had experience as ward-sister, and to have had at least one year as assistant-superintendent and as night-superintendent, in some hospital under a trained lady-superintendent.

(13) The matron must give future matrons or superintendents insight into their duties. There must be an examination and questions given on superintendents' work.

IV. *Current Tests, Current Records of Progress and Examinations.*

(*a*) The candidate should fill up a form of application, answering printed questions. Regulations of training printed on the back.

(*b*) Should enter on a month's trial. She receives the time-table and the list of duties.

If the candidate is accepted after the month as probationer—

(*c*) Each ward head-nurse or sister keeps a record of each probationer, under printed heads corresponding with the list of duties. She fills up the columns with suitable marks once a week. The matron, after examining the ward-sister's reports with ward-sister and 'home'-sister present, and questioning each ward-sister on each probationer, records her own opinion on the sister's reports. The medical instructor should, at appointed times, examine each probationer separately, upon the duties which the ward-sister has 'recorded' her as defective in, in the presence of ward-sister, 'home'-sister, and matron; and also should examine each ward-sister separately upon her records of each probationer in the matron's presence, but not in the probationer's.

The 'home'-sister also furnishes a record of each probationer's conduct at the classes and in the home.

(*d*) A register with two pages for each probationer should be kept monthly by the matron assisted by the 'home'-sister. It corresponds with the ward-sister's book, and has monthly entries for the whole year of training. The accounts in these books must tally at the end of the year, or somebody has been wanting in moral courage.

This register should be supplemented by a further (private) register of the career and character of each probationer who has completed her first year, until she leaves the hospital, and so long afterwards as she keeps in communication with the authorities, and this she should be encouraged to do.

(*e*) While the ward-sisters keep a weekly and the matron a monthly record of the progress of each probationer, she is required to keep a diary of her ward-work, to keep 'case-papers' with the daily changes in case and treatment, and to keep notes of lectures; and the careful examination of these affords important items in the records of results of

training, and of the capabilities of each probationer. The medical instructor enters his verdict on professional points in the monthly register.

(*f*) The medical instructor, and each hospital professor who gives lectures to the probationers, examines them orally in the presence of matron and 'home'-sister. He examines their notes of the lectures and awards marks. It is communicated to each probationer how she stands as to marks.

(*g*) Written questions are given by the medical instructor at least four times a year, to be answered in writing, at least by the probationers who are training to train others. Marks are awarded, and the number of marks received communicated to each probationer. Possibly prizes may be given for proficiency.

These are some of the current tests of the results or non-results of training, of progress or no progress. Without some regular system of this kind, there can be no real organisation for training. The heads of the training school *must* 'take stock' and know where each probationer really stands, and what the training is really doing, and must let each probationer know where she stands. The matron must be one whose desire is that the probationers *shall* learn: a rarer thing than is usually supposed. But besides this there is a constant, motherly, intangible supervision and observation to be exercised, for there are qualities which no written tests can touch and no examinations can reach. The probationers must really be the matron's children; the 'home'-sister must really be their elder sister.

A training school without a mother is worse than children without parents. And in disciplinary matters none but a woman can understand a woman.

V. *Staff of Training School.*

(1) The *superintendent* of the training school is the matron of the hospital, and head of all the women in the hospital. She is present when possible at the probationers' lectures and demonstrations and oral examinations. She is responsible for the selection and dismissal of the probationers, and for the due conduct by those in charge under her (home-sister, ward-sisters) of their training. She holds frequent informal meetings of the female heads of the hospital and 'home' for the purpose of exchanging notes and knowledge regarding probationers and nurses.

(2) The trained '*home*'-*sister* (class-mistress; mistress of probationers) resides in the 'home'; is in charge of the 'home' and its servants and of the probationers. She gives two classes a week at least to the senior nurse-probationers and two to the juniors, drilling them in the medical instructor's lectures, &c. &c. She superintends two afternoons at least in the week the study hours of the probationers training to train others—that is, all who are to be in future in charge of nurses, whether as ward-sisters, matrons, or superintendents—and gives direct instruction on one at least of these afternoons. She gives singing and Bible classes. She attends all clinical and other lectures, demonstrations, and examinations. She reports monthly to the matron, and through her from time to time communicates with the ward-sisters on the merits and defects in the probationers' work and characteristics, and as to what action to take respecting them.

Above all, the 'home'-sister must be the mother of the probationers, really caring for each for her own sake, carrying each on her heart before God. She must know how to make it a real 'home,' with constant supply of all wants and constant *sympathy*, which must be taught by example and by precept. It must be a moral and spiritual home, as well as one for the body and for technical and theoretical instruction.

(3) *Ward-sisters* (head-nurses, training-nurses). The ward-sister must train the probationers in all the duties of a nurse. *See* NURSING THE SICK.

The ward-sister (and equally the home-sister) must not want moral courage to let the probationers know any unfavourable report she has made of them in the Sisters' Records. Not to do so would be unfair to the probationers.

The ward-sister, or—instructed by her—the staff-nurse, is to *show* every new probationer how to do her work; not only what things are to be done, but how she is to guard against the *way* they are not to be done, as well as against what is not to be done. She is to instruct the nurses how to instruct probationers. As it is impossible for a 'sister' with a sister's duty in a 'heavy' ward always to have time to show all needful things herself to the probationer, the sister must from time to time question her to see if she has been shown her duties, and how she does them, remembering that it is of use to the probationers to put these things into words; and for this purpose each probationer is to be occasionally taken by the sister on her ward rounds, and examined as to what she has done in each case under her charge—whether she has learnt to do it rightly and knows 'the reason why.'

The ward-sister must also train the probationers in alacrity of intelligent obedience to *her* medical authorities, which must be the probationer's lesson of what obedience ought to be. She must regard the probationers less as hospital servants, than as pupils to be trained for hospital 'sisters' and nurses. The training-nurse must be a bridge for the pupil-nurses. 'He who will be a chief, let him be a bridge.' She must not make them too little of pupils, too much of assistant-nurses—or, rather, they cannot be too much of assistant-nurses, but being too little of

pupils makes them too little of real assistants, and (for all their future) of real nurses. The training-nurse must interest the pupil-nurse in her cases. The pupil cannot have a nurse's interest in them without knowing *what they are*—she must feel for their suffering. Cases she is interested in she nurses with twice the efficiency.

The key to the whole situation is the ward-sister, through whom the trained matron influences nurses, probationers, ward-maids, and patients throughout the hospital.

When probationers are put on night duty, the night-superintendent is responsible for their training. Night duty is better taken after the first year's course.

(4) *Medical Instructor.*—The medical instructor, one of the hospital staff who will undertake the duties, gives a course of lectures on medical and surgical topics specially connected with nursing duties; demonstrations with anatomical and other illustrations, specially adapted to nurses; lessons on the elementary knowledge of physiology, anatomy, the situation of the principal arteries, &c.; lessons on bandaging; lessons in hygiene, both of wards and patients, and in diet; lessons on the causation of disease; on what is to be done in emergencies; on how to make beds for various operations and diseases, &c. &c. He is to lay down a systematic course of reading for the probationers who are to train others; to examine them by written questions at least four times in the year; to give them subjects for essays, and to examine these; to award marks. He is to examine all the probationers orally; to examine their notes of lectures, to award marks; to examine their case-papers. He is to give clinical lectures at his own 'beds' (it would be desirable if each probationer could end her course of wards in the medical instructor's wards), and to examine 'case-papers' taken of his own cases; to teach symptoms, and what symptoms indicate, and *why* such or such a treatment; and what shows a case to be 'doing well' and what 'ill'; and to teach the probationers so that they can teach other probationers in their turn. He will encourage in every way the professional interest of the nurse in the cases she is nursing; he will point out these cases in medical and surgical books. At appointed times he will examine each probationer separately with a view to ascertain the duties she is defective in; and each ward-sister separately upon her recorded experience of each probationer. He will fill up the register at the end of each probationer's year of training, with his verdict on her capacities, and on the professional results of her training. The medical instructor should be one of mature age and experience; should be really a father to the pupil-nurses, and one whom the matron can freely consult with. If the hospital have a *permanent* resident medical officer fit for the purpose, he should be the instructor.

(5) *Esprit de corps* should be encouraged. It is a great help to think, 'If I do this I shall be a disgrace to my training-school (or hospital). If I do that I shall be an honour to it.' Let nurses be proud of their *alma mater*. Let them think their own training-school and their own doctors the first in the world. Let there be a friendly rivalry with other hospitals, and never try to fuse all nurses into one mass—one indistinguishable mass—of all training-schools or hospitals.

If, however, there has been little or no discipline in the training-school, then the *esprit de corps* will tend to harm and not to good.

Training, General Consideration of. A year's training is simply teaching the nurse her A B C—teaching her how to go on learning for herself, learning to understand her doctor's orders and to read her own experience, for mere experience may only teach the *post hoc, ergo propter hoc*. A nurse without training is like a man who has never learnt his alphabet, who has learnt experience only from his own blunders. Blunders in executing physician's or surgeon's orders upon the living body are hazardous things, and may kill the patient. Training is to enable the nurse to see what she sees—facts, and to do what she is told; to obey orders, not only by rule of thumb, but by having a rule of thought or observation to guide her. Otherwise she finds out her own mistakes by experience acquired out of death, rather than life, or does not find them out at all.

Medicine, surgery, pathology, and, above all, hygiene, have made immense strides, partly in consequence of improved tools, improved instruments of observation. Nursing, their agent, has to be trained up to them. A good nurse of twenty years ago had not to do the twentieth part of what she is required by her physician or surgeon to do now; and so after the year's training she must be still training under instruction in her first and even second year's hospital service. Indeed, every five or ten years a nurse after leaving the hospital really requires a second training nowadays. Nursing needs its instruments nearly as much as surgery, and yet more than medicine. The physician prescribes for supplying the vital force—but the nurse supplies it. Training is to teach the nurse how God makes health and how He makes disease. Training is to teach a nurse to know her business, that is, to observe exactly, to understand, to know exactly, to do, to tell exactly, in such stupendous issues as life and death, health and disease. Training is to enable the nurse to act for the best in carrying out her orders, not as a machine but as a nurse; not like Cornelius Agrippa's broomstick which went on carrying water, but like an

intelligent and responsible being. Training has to make her, not servile, but loyal to medical orders and authorities. True loyalty to orders cannot be without the independent sense or energy of responsibility, which alone secures real trustworthiness. Training makes the difference in a nurse that is made in a student by making him prepare specimens for himself instead of merely looking at prepared specimens. Training is to teach the nurse how to handle the agencies within our control which restore health and life, in strict obedience to the physician's or surgeon's power and knowledge—how to keep the health-mechanism prescribed to her in gear. Training must show her how the effects on life of nursing may be calculated with nice precision—such care or carelessness, such a sick-rate, such a duration of case, such a death-rate.

And *discipline* is the essence of training. People connect discipline with the idea of drill, standing at attention—some with flagellating themselves, some with flagellating boys. A lady who has, perhaps, more experience in training than anyone else, says: 'It is education, instruction, training—all that in fact goes to the full development of our faculties, moral, physical, and spiritual, not only for this life, but looking on this life as the training-ground for the future and higher life. Then discipline embraces order, method, and, as we gain some knowledge of the laws of nature ("God's laws"), we not only see order, method, a place for everything, each its own work, but we find no waste of material or force or space; we find, too, no hurry; and we learn to have patience with our circumstances and ourselves; and so, as we go on learning, we become more disciplined, more content to work where we are placed, more anxious to fill our appointed work than to see the result thereof; and so God, no doubt, gives us the required patience and steadfastness to continue in our "blessed drudgery," which is the discipline He sees best for most of us.'

FLORENCE NIGHTINGALE.

NURSING THE SICK.—Nursing proper, that is, nursing the sick and injured, will be here treated of, and not Preventive or Sanitary Nursing, or nursing healthy children.

Nursing is performed usually by women, under scientific heads—physicians and surgeons. Nursing is putting us in the best possible conditions for Nature to restore or to preserve health—to prevent or to cure disease or injury. The physician or surgeon prescribes these conditions—the nurse carries them out. Health is not only to be well, but to be able to use well every power we have to use. Sickness or disease is Nature's way of getting rid of the effects of conditions which have interfered with health. It is Nature's attempt to cure—we have to help her. Partly, perhaps mainly, upon nursing must depend whether Nature succeeds or fails in her attempt to cure by sickness. Nursing is therefore to help the patient to live. *Training* is to teach the nurse to help the patient to live. Nursing is an art, and an art requiring an organised practical and scientific training. For nursing is the skilled servant of medicine, surgery, and hygiene.

Nursing may be divided under four heads: (*a*) *Hospital* nursing. (*b*) *Private* nursing: that is, nursing one sick or injured person at a time, at home; giving the whole time to that one patient, generally of the richer classes. (*c*) *District* nursing: that is, nursing the sick or injured poor at home, taking as many cases as can be well attended to by one nurse. District nursing, or nursing the sick poor at home, is a branch of nursing of the highest importance, and requires the highest qualifications, because the district nurse has not, like the hospital nurse, a medical and surgical staff always at her call, and never hospital appliances to her hand. (*d*) *Midwifery* nursing, including the nursing of the healthy mother and infant after natural childbirth, the feeding, washing, and clothing of infants, and the teaching the mother the management of her own infant and herself, will not be treated of here. It differs from other nursing in this—that the lying-in woman, the patient, is not, or ought not to be, sick, and that the nursing consists in a surgical operation and in hygienic precautions. It is one of the branches of nursing most important for national health. And there is no organised system of monthly nurse-training available for nurses for the poor. Midwives do not appear to learn it, at least as a part of midwifery. Their training is said to be sufficient for it, because it is *not*. [Midwifery and general cases should not be attended by the same nurse. No ordinary precautions will secure the lying-in case from danger arising out of this practice.]

Nursing proper means, besides giving the medicines and stimulants prescribed, or applying the surgical dressings and other remedies ordered—(1) The providing, and the proper use of, fresh air, especially at night—that is, ventilation, and of warmth or coolness. (2) The securing the health of the sick-room or ward, which includes light, cleanliness of floors and walls, of bed, bedding, and utensils. (3) Personal cleanliness of patient and of nurse, quiet, variety, sympathy, and cheerfulness. (4) The administering and sometimes preparation of diet (food and drink). (5) The application of remedies. In other words, all that is wanted to enable Nature to set up her restorative processes, to expel the intruder disturbing her rules of health and life. For it is Nature that cures: not the physician or nurse. (6) Observation

of the patient. We shall now discuss these duties in succession.

1. Ventilation. Warmth and Coolness.—(*a*) *Ventilation* is the removal of the air poisoned by the breath and other human emanations, and supplying its place with *fresh* air.

The very first canon of nursing is to keep the air inside as fresh as the air outside, by night as well as by day, without chilling the patient. The best rule of ventilation is still: Poke the fire, open the window, but *at the top*, for fresh air coming in at the ceiling permeates the whole room, without causing draught, and foul air escapes. Air coming in at the floor or at the level of the patient remains there and chills him, and foul air does not escape. Always air from the outside air. Windows are made to open, doors are made to shut. If the nurse ventilate the patient's room or ward through the door—that is, making the room draw the foul air from the rest of the house or building—she ventilates him with foul, not fresh air. But ventilation is impossible without sufficient floor and cubic space, and unless the windows open near the ceiling. Where other patients want air, fever patients, for example, want movement of the air; where other sick want a well-aired room, without draughts, pyæmic patients, for example, want the freest possible supply of air about their beds.

(*b*) *Warmth or coolness.*—This the physician has to prescribe—the nurse has to see to it. In fever, for instance, the physician will require her to examine the patient's feet and legs, at least every hour, to ascertain whether they are chilled, and to keep the extremities warm, even though his temperature be high, whether in summer or winter.

In bronchitis, in ovariotomy, &c., an even, high, moist temperature may be necessary, and a steaming kettle may be required on the fire night and day.

But ordinarily it is not advisable to keep the sick-room always at the same temperature. A cooler air at night is necessary. But whether cool or warm, the air must be *fresh.* Sick children become fretful in foul air at night. And young as well as old night-nurses require training to see that the physician's orders are obeyed as to keeping the air of the ward fresh by night, and not above or below a certain temperature.

The head of the sick should never be higher than the throat of the chimney, which ensures the best air. And the chimney should never be closed with a chimney-board or other contrivance.

2. Health of Sick-Room, or Ward.—This might be called 'nursing the room.' The placing the sick-bed in the best position to secure air without draught, light without glare, quiet and cleanliness—and this often necessitates rearrangement of the furniture of the whole room—is one of the essential arts of nursing. In district nursing of the poor, it must be one of the nurse's first duties to put the room in a state so that the patient *can* recover. So, too, must the hospital and the hospital-ward be built so that the patient shall not 'die of hospital.' To get rid of the conditions which have interfered with health is of course the first nursing step in helping Nature to get rid of the effects of those conditions.

(*a*) *Light.*—Second only to air is light as an essential for growth, health, and recovery from sickness—not only daylight, but sunlight—and indeed *fresh* air *must* be sun-warmed, sun-penetrated air. This should be meant to include colour, pleasant and pretty sights for the patient's eyes to rest on—variety of objects, flowers, pictures. People say the effect is on the mind. So it is; but the enlightened physician tells us it is on the body too. The sun is a sculptor as well as a painter. The Greeks were right as to their Apollo.

(*b*) *Cleanliness.*—Cleanliness and fresh air do not so much give life as they are life itself to the patient. Cleanliness—clean air, clean water, clean surroundings, and a fresh atmosphere everywhere, are the true safeguards against 'infection'—not segregation—or rather segregation by ample floor and cubic space, ample ramparts of fresh atmosphere: not segregation by walls and divisions. You cannot lock-in or lock-out the infectious poison; you cannot wall-out infection. You *can* air it out, diffuse it, and clean it away.

'Infectious Hospitals' and 'Wards,' whether necessary or not, are not a part of hygiene; and the doctrine of 'disease germs,' in the sense in which it may lead to considering 'infection' inevitable, must not be taught as a principle of sanitary nursing. That there is no such thing as 'inevitable' infection, is the first axiom of nursing.

Cleanliness of floors, ceilings, walls, bed, bedding, and utensils, and of sinks; also of lockers, if any—but there should be none.

Floors and walls.—Medical men forbid scrubbing in the sick-room. No sick-room floor ought ever to be washed, except by the doctor's orders and at the hour he orders.

The only clean floor is a floor planed, saturated with 'drying' linseed oil, well rubbed-in, stained (for appearance' sake), not too dark, so as *not* to hide the dirt, and bees-waxed with turpentine and polished. The floor to be wiped with a damp cloth and dried with a floor-brush, or cleaned by a brush with a cloth tied over it. Anything offensive spilt to be washed off at once with soap and water. Hospital-ward floors should be scraped and polished every fortnight by a *frotteur* and dry-rubbed by a man every day. The patients should be provided with slippers. No carpet, of course, in a sick-room, except a piece of washing drugget by the bedside. A dirty carpet literally infects the room.

The only clean wall is one that is oil-painted or of glazed tiles. From this you can wash the animal matters. These are what make a room musty. The worst wall is the papered wall. The next worst is the plastered wall. But the plaster can be made safe by frequent lime-washing and occasional scraping. The paper requires frequent renewing. A glazed paper gets rid of a good deal of the danger. But the ordinary bedroom paper is all that it ought not to be.

Furniture—as little as possible in the sick-room—should all be of polished wood, metal, or marble, kept clean by being wiped with a cloth wrung out of hot water.

Air can be soiled just like water. Air is always soiled where walls and carpets are saturated with animal exhalations. Dust consists greatly of organic matter. There should be no ledges out of reach capable of holding dust. An Arnott's ventilator in the chimney will keep an ordinary paper longer clean, showing the connexion of ventilation and cleanliness. Inattention to these essential matters all but foils the best nurse's best efforts.

How to clean.—Dust is the harbourer and harbinger of disease. Dust in hospitals may contain epithelial scales from the mouth, skin-epiderm, pus-cells. As there appears no limit to the reproduction of epiderm or epithelium, so there is no limit but excessive cleanliness to its deposit in dust in a hospital-ward, 'which,' as a great surgeon has said, 'never rests from fouling itself.'

The only way to *remove* dust is to wipe everything with a damp cloth. And all furniture ought to be so made that it may be wiped with a damp cloth without injury to itself, and so polished or glazed that it may be damped without injury to us. Flapping, by way of dusting, is not cleaning. To 'dust,' as now practised, merely means to distribute dust more equally over a room. To 'tidy' a room, or 'put the room to rights,' means to remove a thing from one place which it has kept clean for itself on to another and a dirtier one.

No one atom of dust ever actually leaves the room under the present system of 'dusting.' The greater part of nursing consists in keeping clean. No ventilation can freshen a sick-room where the most scrupulous cleanliness is not kept.

Bed and bedding; linen, &c.—Feverishness is generally supposed to be a symptom of fever; in nine cases out of ten it is a symptom of bedding. The patient has had reintroduced into his system the diseased emanations from himself, to eliminate which from his system Nature had appointed the disease. These, day after day and week after week, soak into his unaired bedding from below as well as from within, if the chamber-utensils are left, as is too often the case, unemptied and without a lid under the bed. Erysipelas and pyæmia are produced by an uncleansed state of bed and bedding. Black flock is sometimes used for fracture pillows. This gets full of dust, and may be the cause of erysipelas. The feather-bed is dangerous dirt's most favoured nest. Feather-beds should be picked to pieces and the tick washed at least once a year. One of the results of the feather-bed unpicked, say, for twenty years, with perhaps several lyings-in taking place on it, besides ordinary use, may be fatal pyæmia to the mother and sores to the infant. The infant may be kept during the first weeks of its life in a suffocating heap of steaming dirt. Babies are the best test of sanitary conditions. Such foul air dwarfs their bodies and poisons their blood. That patients are 'accustomed to the filth and it does them no harm,' is not only thought but said even in the present year of grace (or disgrace) 1893.

The most dangerous effluvia we know are from the excreta of the sick; these are placed, at least for a time, where they must throw their effluvia into the under-side of the bed, and the space under the bed is never aired; it cannot be with our arrangements—a valance or counterpane down to the floor, or perhaps the quilt so carefully pinned over that no air can pass under the mattress.

An adult in health exhales by the lungs and skin in the twenty-four hours three pints at least of moisture, loaded with matter ready to putrefy; in sickness the quantity is often greatly increased—the quality is always more noxious. This goes chiefly into the bedding because it cannot go anywhere else; and it stays there, because, except perhaps by a weekly or bi-weekly change of sheets, scarcely any other airing is attempted. A nurse will be careful to fidgetiness about airing the clean sheets from clean damp, the clean night-gown from clean damp, the new mattress from clean damp; but airing the dirty sheets from dirty damp, the dirty night-gown (which she is going to put on the patient after washing him) from dirty damp, never so much as occurs to her. And a mattress is supposed to be aired by somebody else sleeping on it and saturating it with his own damp before the patient comes to exhale into it the patient's damp.

The bed is *always* saturated with the patient, and the unfortunate patient who lies in it is always being saturated with the bed.

The ordinary sick-bed of a private patient is generally exactly what it ought to be to bring this poisoning process to perfection: a wooden four-poster with curtains, two or even three mattresses, or even a feather-bed, piled up—perhaps to a height above the throat of the chimney or above the lower chink of the sash-window, which is all that is ever opened; the window not opening or opened at the top; a valance fastened to the frame. Nothing

ever thoroughly dries or airs such a bed and bedding.

The best bed and bedding are: An iron bedstead with rheocline springs, or the woven-wire mattress, no valance and no curtains, of course; one thin hair mattress, light Witney blankets, no heavy cotton counterpane, which retains perspiration; no blanket *under* the patient, which acts like a poultice and promotes bed-sores—bed-sores which are, all but always, a symptom not of the disease but of the nursing.

The patient should, if possible, be able to see out of window from the bed.

Two beds, one for the day and one for the night, are desirable for the best nursing of the patient. A true nurse always knows how to make a bed, and always makes it herself. And bed-making has much to do with bed-sores. She hangs up the whole of the bedding to air for a few hours whenever possible. She makes the changes of linen and bed-linen—sheets and draw-sheets—as often as is necessary, which is a great deal oftener than is usually done. In hospitals, she sees to no patient using his neighbour's towel; and to different towels being used for different purposes. In private houses cases of purulent ophthalmia, ending in blindness, have been known to have occurred from the use of a soiled towel by another member of the family. She sees to all dirty linen, and especially bandages, being instantly removed and disinfected. No disinfection will enable dirty linen to be kept with safety a single day in the same building with the sick. It is cruel to allow dirty linen from 'infectious' patients to be taken home by the relatives to be washed in the crowded rooms of the poor. Dirty linen should be removed immediately from the sick-room and sent to the laundry, at least every day. If we are careful to take away and empty bed-pans directly, surely this is still more important with soiled sheets. It must not be supposed that even a good sprinkling of carbolic powder (which, besides, injures the sheets) over the dirty linen lying in a basket, will at all obviate the necessity of instant removal. Steeping in boiling water with an antiseptic solution (carbolic acid 1 in 100) is the only safe method of disinfection. All washing of dirty linen and bandages should be done outside of the sick-room and, if possible, of the house. In a hospital the laundry should be in a separate building.

Bandages with pus on them are always to be burnt at once—to be carried straight to the ward-fire, or to a furnace. The best economy is to burn them; but one must make up the fire so that the burning shall not smell. Bandages used for fractures, &c., are the only bandages that may be washed. Soak these with chlorinated soda, a diluted pint; then boil them all night with soft-soap, soda, and chlorinated soda—a quart bottle for the two. The bandages are then to be rinsed in a tub. The boiler must, of course, only be emptied in a closet-sink.

All disinfectants are more or less a 'mystic rite,' as a great surgeon said. Absolute cleanliness is the true disinfectant; but chlorinated soda, if disinfectants are to be used, is about the best. Always have chlorinated soda for nurses to wash their hands, especially after dressing or handling a suspicious case. 'It may destroy germs at the expense of the cuticle;' but, 'if it takes off the cuticle, it must be bad for the germs,' said the same surgeon. Fire is the right way, if a thing is so bad that it wants a disinfectant. Hair (and all hospital beds should be of *hair*) should be heated to about 350°, teased, and exposed to air. Boil, wash, scour with much soap and water and, say, chlorinated lime; then dry and expose to air all bed-ticks, blankets, coverlids, &c.

Utensils.—All chamber-utensils and bed-pans should be of white glazed earthenware with well-fitting lids. None should ever be left under the bed, but be brought to the room, and, when used, carried immediately to the closet-sink, emptied, and rinsed there. No zinc pail, or pail without a lid, should be carried through a ward or sick-room. The pail should be of glazed earthenware with a lid. But better no pail at all in a sick-room. Without care for these things, the doctor will tell us, 'it is impossible to nurse.' Excreta have often to be put by for medical inspection; the nurse must see to this being done properly and inoffensively, in a closed vessel—never in the patient's room or ward. As for urine, if it has to be measured and tested, there are glass-measures, with covers, fit for the purpose. Bed-pans should have carbolic powder in them lavishly. All bed-pans should have lids. Glass urinals, with wide necks, washed with warm water and soda, are the only really clean ones; zinc and white earthenware, with long necks, are never clean. After being used, they should be put by the bedside, not under, and taken away and emptied at once. Small white chamber-utensils are useful, and district nurses may find old jam-pots the cleanest thing for urinals. Chamber-utensils in a hospital should be ranged on their sides in a sort of hutch open to the outward air through perforated zinc, in the lavatory or other compartment. If in a large hospital-ward chamber-utensils *must* unhappily be allowed under the beds at night, they should all, of course, have lids. Two glazed earthenware (not zinc) pails, with lids, may then be carried round the last thing at night and the first thing in the morning; one pail to empty into, with some carbolic powder in it; one pail to rinse with, with soda or chlorinated soda in it. The chamber-utensils should be then carried off to the hutch in the lavatory. But this is only a *pis aller*; a slop-pail should really never be brought into a sick-room or

ward at all. It should be a rule, invariable—rather more important in the private house than elsewhere—that the utensil should be carried directly to the water-closet, emptied there, rinsed there, and not brought back till it is wanted.

There should always be water and a tap in every water-closet for rinsing.

Towels in a hospital should be kept separate for three separate uses, changed for clean ones as often as possible, and marked 'Hands,' 'Bed-pans,' and 'Basins.'

A bottle of chlorinated soda and a bottle of glycerine should always be by, to wash the hands.

A young nurse, dressing an ulcerated leg, has been known to wipe it with the sheet, and alleged that she had seen it done elsewhere! There should always be a special towel for such cases. *Charcoal* may be employed in offensive cases; it may be placed under the bed in pans, or under the limb (if slung) in the bed. Carbolic powder may be placed in the chamber-utensil (clean) if under the bed, or little bags of carbolic powder in the bed. Condy's fluid is sometimes placed in saucers, but thus used is not of much use. Carbolised tow may be used for cancer cases to lie upon, and changed frequently. Wool, with salicylic acid, is sometimes used to cover the dressing of an offensive wound, or salicylic lotion for a warm-water dressing. Slop sinks may be sluiced down with carbolic acid. *Water-closet pans* should be scrubbed with strong nitric acid, if they have been allowed to get at all offensive. Urinals, if allowed to become furred, must be sluiced out with boiling water, and then, if necessary, scraped with a knife all round and inside the grating. Also water-closet slop sinks. These all should be scrubbed with sand and chlorinated soda at least twice a week. In hospitals the head-nurse ought to mop-out and rinse-down the urinals every morning herself with a little bed-pan mop, and let boiling water run through; the same with the water-closet pans. The lavatory basins, when used, should be mopped-out every morning, and scrubbed at least twice a week with sand. There should be two mops—one new one for lavatory basins, appropriated when a little old to the bed-pans, and the old one replaced with new; the new small mop to hang over the lavatory basins, the old one to hang over the slop-sink for bed-pans; an old bottle-brush for the handles of bed-pans, a new bottle-brush, kept in the ward-kitchen, for bottles. Ordinary basins should be washed with tow.

3. **Personal Cleanliness, Precautions against Finger-poisoning, &c.**—One of the most important points nurses have to be taught on beginning surgical ward-work (and, indeed, surgeons also), is how not to poison their fingers. No good nurse will poison her own fingers any more than her patient's.

The following rules should be strictly observed, noting only that many other disinfectants are now in use besides carbolic acid and carbolic oil:—

Pare the finger-nails close; keep them, as well as fingers and hands, scrupulously cleaned; anything which has soiled the fingers is a possible source of contagion to others and to yourself: a hang-nail, or crack, or scratch, or pin-puncture, is as likely to produce a poison-nest to others or to yourself, even more than an open wound or sore. Such poison-nests must be made harmless by first washing with pure water, next by applying styptic colloid, thirdly by putting on some kind of finger-stall. Immediately *before* beginning any dressing, and in every case *after* touching the patient, whether in dressing wounds, rubbing in applications, administering enemata, internal syringing, washing out eyes, ears, nose, mouth—dip the hands into watery solution of carbolic acid, 1 in 80, and then wash hands and nails carefully with carbolic soap. 'Dressing forceps,' or syringe, or whatever is used, to be dipped in solution of carbolic (1 in 80) *before* use as well as *after*. The teeth and joints of the 'dressing forceps' to be brushed clean. Remove soiled dressings with 'dressing forceps,' and not with the fingers; on no account scratch up adhesive plaster or other adhering dressing with the nails. Nurses of the old school will boast that they are not afraid. The fear of dirt is the beginning of good nursing. With all internal cases, keep the nails short, fill the same with carbolic soap, and carefully anoint the fingers you are about to use, especially the first and second fingers in attending on vaginal cases, with carbolic oil (1 in 20). Oil the tube or nozzle, &c., to be used for any internal application, with carbolic oil (1 in 20). Otherwise the appliance used might convey contagious matter from one patient to another. Always use two basins in washing wounds, so as not to dip the fingers in dirty water. Catheters must be cleansed and disinfected, first with a stream of warm water, and then with a stream of watery solution of carbolic acid (1 in 40). Catheters of other material than silver should *not be soaked* in carbolic acid solutions, as the acid injures varnish and gum. Never 'blow down' towards the eye *first* instead of last, for so some lodgment will always be effected at the bottom. Never fail to take your own carbolic soap, with which you will be provided, in your own soap-tin, into the ward each morning and evening in your pocket. But take it out before beginning 'dressings,' as otherwise you put a dirty hand into your pocket. Always dry your cleaned fingers and hands on towels *not* used for any other purpose. After offensive cases, blow the nose and expectorate, and rinse mouth and throat with Condy and water, or with permanganate of potassium—a few grains in water. Cuffs and sleeves and stuff dresses

are possible carriers of contagious matter. Always change the apron and over-sleeves which you have worn about the sick before eating or drinking. Report immediately any scratch or hang-nail or sore you may have to the ward-sister; ask immediate advice after breathing in offensive air. Never go on duty in the morning without having taken a meal.

The nurse must be taught the nature of contagion and infection, and the distinctions between deodorants, disinfectants, and antiseptics.

Mischief done by students and dressers might have been saved, and valuable lives spared, even among surgeons, if such precautions had been always scrupulously observed by them.

4. **Food and Drink (Diet).** — The physician will tell us that, to give food and stimulants in the way, at the time, of the kind, with the cooking and preparing, that will best enable the poor enfeebled digestion to assimilate it, is one of the great nursing arts. No chemical rules can be given for this as absolute. The patient's stomach is the laboratory, and also the chemist. It is the sole judge of whether the physician's orders are right, and the nurse has to watch and tell him what the patient's stomach says. She must be of course trained and cultivated to understand what it says.

The patient's stomach sometimes craves, and assimilates too, what no rules would have prescribed for it. The nurse must ask the physician whether she may gratify these cravings. Sick-cookery should do half the digestion's work; and proper variety is essential. If a patient is sick after taking food or drink, or feverish, or faint, or torpid, it is often a symptom not of the disease but of the nursing. Indeed, how much of the suffering of illness, as well as of its danger, is the fault not of the illness but of the nursing, is well known to the skilful physician and surgeon.

The nurse, of course, has nothing to do with the prescribing of stimulants any more than of medicines. But life often depends —especially in fevers and severe surgical injuries—upon the nurse knowing how to follow the indications of the changes to be looked for in the patient's state given her by the physician, and to change the times of giving the stimulants accordingly.

The nurse must know how to make gruel, arrowroot puddings, egg-flip, drinks, good beef-tea, and other kinds of sick cookery, so as to please the patients' taste and vary their diet. People say 'fanciful patients' must be 'humoured.' So they must; but it is in order to excite the proper secretions of saliva and gastric juice necessary for digestion. Nothing should ever be cooked in the ward or in the patient's room.

But though 'sweet Jack Falstaff' says 'A nurse is a cook,' the whole of the cooking must not be thrown on the nurse, if she is to nurse; and above all, if she is to eat, she must not be expected to cook for herself. But she will always be required not only to see that the patient's food and drink be as prescribed, but that it be well cooked, and punctually and well served. The physician considers that upon the nurse's power to give weak patients food in the way they like often depends their taking, or at least assimilating, any food at all.

She has also to feed, for example, fever-cases so that they can eat. The mere lifting-up of a patient in bed to give him food may terminate fatally a fever-case. The nourishment or stimulant ordered may have to be put into his mouth perhaps every half-hour — perhaps every five minutes — even during sleep, without rousing the patient— the test of a good nurse. The physician expects the nurse to be able intelligently to make the variations he prescribes in giving these things, especially during the night, according to the state of pulse and other symptoms, which she must know how to observe, in order to follow his conditional directions, upon which hangs the patient's life from hour to hour, often from minute to minute. In convalescence from typhoid fever, one single false indulgence has often induced a relapse and terminated a case fatally.

5. **Application of Remedies.** — The physician or surgeon requires the nurse—

To be able to dress blisters, burns, sores.

To administer stimulants and medicines as ordered, enemas and injections to men and women, and suppositories.

To manage trusses, appliances in uterine complaints; to pass the catheter—at least for women. The district nurse is often now required to pass the speculum for women, also the catheter for men, because there is no one else to do it.

To use the best methods of friction to the body and extremities; to make and apply fomentations, poultices, and minor dressings, wet and dry or greasy; to syringe wounds; to syringe the vagina.

To manage helpless patients—fever, operation, and surgical cases—that is to move, to change them, to keep them personally clean, warm or cool.

The medical attendant will expect the nurse to maintain an exquisite cleanliness of the patient's whole person and skin, and, as in fever—the daughter of dirt—to clean herself the patient's teeth, gums, and tongue, with lemon-juice or white-of-egg beaten to a froth. A nurse is no nurse who cannot wash or sponge a patient's whole body *without exposure or chill to any part.* In typhoid and other fevers, this is often an essential part of the treatment.

To give food and stimulants to helpless patients—fever, operation, and surgical cases; to manage the position of such cases; to prevent or to dress bed-sores.

To make the sick-bed, and especially to make the bed with the patient in it; to change the under-sheet without moving the patient, as in fever and operation cases. The 'best way' includes, in this as in all other things, the doing them at the least expense to the patient's vital powers.

To prepare the bed for fever, for accidents, for ovariotomy, and various kinds of operations; to undress, handle, and put to bed accident cases.

To attend at and prepare for operations—including ovariotomy, lithotomy, hernia; to prepare patients for and manage them after operations and anæsthetics—and all this with the least call upon their small strength.

To be able to do the first thing in case of hæmorrhage, namely, compression by hand or finger, by extemporary tourniquet and plugging.

To bandage all the various parts of the body, arm, leg, and chest (in Paris the *infirmiers* of military hospitals are made to practise all this, till not only it is done perfectly, but in a given number of minutes).

To make bandages of the various kinds used: T-bandages, double-headed, compound, 4- and 6-tailed, many tailed, finger, ovariotomy, triangular, perinæal, starched, and plaster-of-Paris, and other stiff bandages.

To make rollers, to line and pad splints, to make leather and gutta-percha splints, fracture and chaff pillows (black flock fracture-pillows harbour dust), and sand-bags.

The nurse should be able to give subcutaneous injections, to use the galvanic battery, to dry- and wet-cup, and to apply leeches externally and internally.

She is required to be able to apply dry and moist heat; to give inhalations and use the spray-disperser; to apply cold, with the use of siphons and with ice; and antiseptic treatment. Every surgeon and physician has his own 'antiseptic solutions,' his own 'disinfectants,' and every year brings fresh ones. And what is ordered must of course be used by the nurse.

6. **Observation of Patients.**—The physician and surgeon require every nurse to be able to observe correctly, and to report correctly, on the state or character of secretions, expectoration, pulse, skin, appetite; effect of diet, of stimulants, and of medicines; eruptions; the formation of matter; as to intelligence, with regard to delirium, stupor, &c.; as to breathing, whether quick or slow, regular or irregular, difficult, &c.; as to sleep, whether sound, starting, heavy, &c.; and as to the state of wounds. The physician also requires the nurse to be able to 'take' and to record the temperature—sometimes every quarter of an hour in critical cases, the pulse, the respiration; to measure, and sometimes to test the urine for him. She will be required to make these observations—if possible still more accurately—for child-patients, who cannot tell what is the matter with them; to understand the management of sick children and children's wards, which need a yet more exquisite cleanliness. And children show a much more rapid change of symptoms for life or for death generally than adults. Children are the best air-test, the best test of sanitary conditions.

Other Duties.—She must understand the management of convalescents—a whole department of nursing in itself—and the sooner a convalescent, especially a convalescent child, is removed from hospital to a country 'home' the better.

Housekeeping.—She must understand a certain amount of housekeeping or domestic economy—rather an uncommon talent. She must be able to order the proper quantity of bread, milk, butter, &c., and to prevent waste.

She must be competent for the charge of linen—a most important item of nursing, when we consider that on extreme cleanliness of bed and patient's linen—in other words, on linen and nurse, depends the not reintroducing disease into disease.

Generally.—Nursing is, above all, a progressive calling. Year by year nurses have to learn new and improved methods, as medicine and surgery and hygiene improve. Year by year nurses are called upon to do more and better than they have done. It is felt to be impossible to have a public register of nurses that is not a delusion.

Further, year by year, nursing needs to be more and more of a moral calling.

Night-nursing.—The physician or surgeon requires the night-nurse to be as good as the day-nurse, or even better—for the most critical times of fever and severe surgical injury often occur at night, or in the very early morning. But quite the same kind of business capacity is not required in the night-nurse as in the nurse in day charge of wards. Night-nurses, to do their work well, must have at least seven or eight hours in bed where they can sleep undisturbed by day (even horses in the New York 'Horse Hotel,' which work by night, have a separate dormitory to sleep undisturbed by day). They must have hot meals prepared for them when they come off duty in the morning, and before they go on duty at night; besides breakfast at 1 or 2 A.M. They must have one and a half or two hours' exercise. In a hospital they should be obliged to show their pass. It is rather more necessary for a night-nurse to be regular in her habits, if she is to be well and efficient, than for a day-nurse. And there appears no reason why nursing by night, if properly managed, should be more trying than by day. But regularity

of habits, of meals, of sleep, of exercise, of personal cleanliness, is the *sine quâ non.* Occasional breaks or transfers to day duty may be necessary; or a night or two in bed every month for a night-superintendent. But a too frequent shifting (*e.g.* every month or every three months) from day to night duty seems hardly advisable, for it takes some time for a nurse to accustom herself to sleep by day. A night-nurse may deteriorate in two ways, if not carefully cared for: (1) She may become 'bumptious,' as if she were the 'sister.' (2) On the other hand, she may become careless and hard from having too much to do to do it properly. The night-nursing in the medical wards of a large hospital is generally much 'heavier' than in the surgical wards, and the matron ought to know from her own experience when the night-nurse absolutely requires additional help, and to provide it. Instant help should also be within call in an emergency, such as a patient becoming suddenly delirious. And the night-superintendent should always be on the watch for emergencies.

Holidays.—All nurses, especially night-nurses, must have holidays, as well as occasional recreation. A month's regular holiday in the year is not too much. Yet more do matrons and superintendents and all women filling nursing offices of great responsibility require an annual holiday, if they are to maintain vigour of body and mind, and not to wear out prematurely.

What a Nurse is to be.—A really good nurse must needs be of the highest class of character. It need hardly be said that she must be—(1) Chaste, in the sense of the Sermon on the Mount; a good nurse should be the Sermon on the Mount in herself. It should naturally seem impossible to the most unchaste to utter even an immodest jest in her presence. Remember this great and dangerous peculiarity of nursing, and especially of hospital nursing, namely, that it is the only case, queens not excepted, where a woman is really in charge of men. And a really good trained ward 'sister' can keep order in a men's ward better than a military ward-master or sergeant. (2) Sober, in spirit as well as in drink, and temperate in all things. (3) Honest, not accepting the most trifling fee or bribe from patients or friends. (4) Truthful—and to be able to tell the truth includes attention and observation, to observe truly—memory, to remember truly—power of expression, to tell truly what one has observed truly—as well as intention to speak the truth, the whole truth, and nothing but the truth. (5) Trustworthy, to carry out directions intelligently and perfectly, unseen as well as seen, 'to the Lord' *as well as* unto men—no mere eye-service. (6) Punctual to a second, and orderly to a hair—having everything ready and in order before she begins her dressings or her work about the patient; nothing forgotten. (7) Quiet, yet quick; quick without hurry; gentle without slowness; discreet without self-importance; no gossip. (8) Cheerful, hopeful; not allowing herself to be discouraged by unfavourable symptoms; not given to depress the patient by anticipations of an unfavourable result. (9) Cleanly to the point of exquisiteness, both for the patient's sake and her own; neat and ready. (10) Thinking of her patient and not of herself; 'tender over his occasions' or wants, cheerful and kindly, patient, ingenious and *feat.* The best definition can be found, as always, in Shakespeare, where he says that to be 'nurse-like' is to be

> 'So kind, so duteous, diligent,
> So tender over his occasions, true,
> So feat.'

A patient wants according to his wants, and not according to any nurse's theory of his wants or 'occasions.' 'Tender over his occasions' she must be; but she must have a rule of thought; and this the physician or surgeon has to give her in his directions; which her training must have fitted her to obey intelligently, using discretion. The nurse must have simplicity and a single eye to the patient's good. She must make no demand upon the patient for reciprocation, for acknowledgment or even perception of her services; since the best service a nurse can give *is* that the patient shall scarcely be aware of any—shall perceive her presence only by perceiving that he has *no* wants. The nurse must always be kind and sympathetic, but never emotional. The patient must find a real, not forced or 'put on,' centre of calmness in his nurse. To call upon a patient by emotion for emotion is the most cruel, because useless, demand upon his strength. It is asking him to bear your troubles and your anxiety as well as his own. Suppressed emotion is as bad—it makes the nurse constrained. It is exposing the patient to both frost and fire. Half the battle of nursing is *to relieve your sick from having to think for themselves at all*—least of all for their own nursing.

FLORENCE NIGHTINGALE.

NUTMEG-LIVER.—A form of disease of the liver, the appearance of which on section somewhat resembles that of the cut surface of a nutmeg. *See* LIVER, NUTMEG.

NUTRITION, Disorders of.—The nutrition of the body, by which we understand the maintenance of its parts in a fit state to perform their functions, depends on three main factors—the supply of suitable food; the assimilation of food; and the prevention or control of waste. When any of these factors are disturbed disorders of nutrition result. If food be inadequate or unsuitable, other things being normal, general atrophy will be the consequence (*see* ATROPHY, GENERAL); and the same result will evi-

dently follow if the organs of assimilation are at fault, or if waste be excessive, even though food be abundant. Hence cancer of the stomach on the one hand, and diabetes mellitus on the other, may be taken as the types of 'wasting diseases.' Increased supply of food, on the other hand, does not improve the nutrition or cause hypertrophy with the same certainty as want produces atrophy, but the increased growth, if any, is chiefly of a single tissue. *See* HYPERTROPHY; and OBESITY.

Similar principles apply, *mutatis mutandis*, to local nutrition or the nutrition of parts of the body; in which the three factors are—the supply of nutritive material by the blood; the power of assimilation possessed by the tissues, depending on the condition of their minute elements; and the amount or rapidity of waste. Hence, local atrophy results from obstruction in the blood-supply to a part; or from the inability of the part to appropriate nourishment, either through faulty innervation or the condition of the tissue-elements. In some cases excessive use, leading to waste, is also a cause of local atrophy. Increased blood-supply alone does not, on the other hand, by itself lead to hypertrophy. *See* ATROPHY, LOCAL.

When the disturbance of nutrition, however produced, causes a qualitative rather than a quantitative change in the tissue or organ, this change receives the name of *degeneration*, of which there are several kinds (*see* DEGENERATION). There are also some instances of disordered nutrition, which are not precisely cases of atrophy or hypertrophy, but are yet dependent on disturbances of some of the factors of nutrition spoken of above. In these cases, supposing that the blood-supply is not interfered with, the assimilative power of the tissues must be in fault, and this will depend upon either innervation or the condition of the tissue-elements. In some of these the nutritive disturbance leads to inflammation.

There are many curious instances of local changes of nutrition in which the blood-supply is quite unimpaired, and the cause has to be sought in some other disturbance, more especially one of the nervous system. Reasoning from certain well-marked cases of disorders of nutrition originating in the nerves, it may be plausibly conjectured that many other changes, and particularly many ordinary diseases, which we usually regard as idiopathic, may similarly be due to disturbance of nervous influence. Again, the nutrition of a part may be affected, not by direct nervous influence, but by reflex innervation, and thus depend upon the condition of some other organ. A very clear instance of a lesion of nutrition depending on the nerves is seen in the disease herpes zoster, and in some other skin-diseases, the distribution of which is obviously regulated by the distribution of certain nerves. In herpes zoster distinct changes have been found in the ganglia—*e.g.* the Casserian ganglion in herpes of the fifth nerve, which must be regarded as the origin of the morbid process. The dependence of nutrition upon the nervous system is also seen in some instances of healing, as in the case of ulcers of the leg, pointed out by the late Mr. Hilton, where rapid healing follows the section of a nerve-branch leading to the ulcerated patch. On the other hand, the loss of vitality dependent on nervous disturbance is seen in the rapid formation of bed-sores on the sacrum in cases of paraplegia, and in perforating ulcer of the foot; the relation of which to affections of the spinal cord and peripheral nerves is clearly made out. The same conclusion must be drawn from the nutritive disturbances, beside the ordinary disturbance of the sensory or motor function of the nerves, which sometimes follow injuries to nerves. Thus injuries of the brachial plexus, not severe enough to cause actual paralysis of motion, may produce a state of swelling and hyperæmia in the fingers—the condition called 'glossy fingers' by Sir James Paget. Similar and more complicated changes have been observed as the consequence of gun-shot-wounds affecting the nerves. These cases, and such as these, have raised the question whether there are 'trophic nerves,' that is, whether, in addition to the fibres passing to the muscles and to the periphery which are concerned in motion and sensation respectively, there are others distributed to the tissue-elements themselves, whose function it is to keep these elements in a proper state of nutrition. It is impossible to discuss this theory here; but we can only say that some of the phenomena which are thought to make necessary the theory of trophic nerves appear to be explicable by assuming the presence in the mixed nerve-trunks of some fibres derived from the sympathetic system. The connexion of the sympathetic nerve-fibres with nutrition, though chiefly displayed through variations in the circulation, is undoubted. In the rare cases which have been observed in the human subject of lesion of the sympathetic nerve in the neck, a permanent change in the nutrition of the affected part is observed when the well-known vascular changes have passed away or become greatly modified. On the other hand, certain affections of the fifth nerve show definite changes of nutrition independent of vascular disturbance, *e.g.* morphœa and facial hemiatrophy. Lastly, it should be pointed out that in certain diseases of the spinal cord, for example, tabes dorsalis, affections of the joints, resembling chronic rheumatism, have been observed, which may be very plausibly, though not yet with certainty, ascribed to nervous derangements. On the strength of these cases it has been supposed

that in other forms of rheumatic and rheumatoid disease, the distribution of the morbid changes depends upon the nervous system; but this must be regarded as quite theoretical. Still more uncertain are the theories which have been framed to explain the occurrence of internal diseases, such as inflammation of the lungs, &c., as a direct consequence of nerve-lesions.

When we find disorders of nutrition neither caused by changes in the distribution of the blood, nor connected with any nervous derangements, the fundamental change must be referred to the tissue-elements themselves; it is probable that the number of disorders depending upon such changes in the minute tissue-elements is very large, and the field of 'elemental pathology' may be larger even than that of nerve-pathology or blood-pathology. Such an explanation is particularly reasonable when the changes are symmetrical on the two sides of the body, and when they are connected with advancing age; as, for instance, fatty degeneration of the cornea, turning grey of the hair, and primary degeneration of the walls of arteries. In these cases it seems unnecessary to suppose any implication of the nervous system, and disturbances of the circulation plainly do not account for the facts. It can only be supposed that the tissue-elements, like the organism itself, have their natural term of life, and that this term varies in different individuals, in whom, therefore, these failures of nutrition are merely the expression of the more or less premature old age of certain elements. For instance, the hair of the head has evidently a shorter term of life in men than in women. These changes may be, and often are, the expression of the general condition of the whole body, which is more obvious in some parts than others, simply because the tissue-elements in these parts are older or less vigorous.

Finally, it must be said that certain general changes of nutrition have been shown to be caused by wasting or destruction of blood-glands, *e.g.* the thyroid, which is related to the disease myxœdema. Possibly it may turn out that other blood-glands have similar relations to general nutrition.

Treatment.—Having spoken of the chief causes of disorders of nutrition, it remains to consider whether there is any general treatment applicable to such disorders, independent of the special treatment proper to many of them as special diseases.

With regard to the general nutrition of the body, we can only refer to what has been said under the head of Atrophy, General, since hypertrophy is not a condition which practically requires treatment, unless exceptionally, as hypertrophy of a special tissue. With regard to local disorders of nutrition, the first and only generally applicable rule must be to remove, if possible, the local cause. If the cause is obscure, or, when discovered, cannot be obviated, the treatment must be guided by circumstances, but will usually be more of a *general* character. As an example of the removal of the cause of disordered nutrition, we have instances in which the phenomena of nerve-lesion above referred to have disappeared entirely on removing a fragment of lead or other irritating substance from the nerve-trunk. A more familiar instance is where the lower part of the leg is in a permanent state of malnutrition from stagnation of blood in varicose veins; œdema, eczema, subcutaneous induration, and ulcers may result. If, by suitable pressure or surgical treatment of the diseased veins, the circulation is rendered normal, all these morbid conditions will be healed. On the other hand, certain local disorders of nutrition can only be treated by improving the nutrition of the whole body. Cachectic children, for instance, may exhibit chronic conjunctivitis, bronchial catarrh, eczema of the flexures, and the peculiar sloughing sores of the fingers which have no distinct name, but are well-known indications of malnutrition. If, in place of, or in addition to, local treatment, we use general treatment, directed to improve the nutrition of the body, all these local disorders may entirely and perhaps simultaneously get well, as they depend only upon the deficient power of resistance possessed by the tissues in general.

J. F. Payne.

NYCTALOPIA, or NIGHT-BLINDNESS (νύξ, night; and ὤψ, the eye; the letters 'al' probably represent *alpha privativum*, and express *want of*).—Synon.: Fr. *Nyctalopie*; Ger. *Nyctalopie*; *Nachtblindheit*.—By the term 'nyctalopia' is meant an abnormal degree of impairment of vision at night, or whenever the light is dim. The degree of impairment ranges in different cases from slight embarrassment to practical blindness. During the day or in a good light the vision may be of normal acuteness, but rapidly fails at dusk.

Like hemeralopia, the term 'nyctalopia' has been used in the opposite senses of *night*-blindness and *day*-blindness (*see* Hemeralopia). Most modern writers have used it in the latter signification; but all the ancients, and nearly all the later writers to the end of the seventeenth century, used it in the former. Aristotle, Galen, Oribasius, Aëtius, and Paulus Ægineta among the Greek, and Pliny among the Latin, writers, all employ the term and its cognates as signifying *night*-blindness. An apparent exception occurs in the second book of the pseudo-Hippocratic treatise, entitled *Prorrhetics*, where nyctalopes are said to be those who *see* at night. There are, however, several reasons for believing that the ordinary text is here incorrect. There is at least one good manuscript which gives the reading,

'those who do *not* see at night,' &c.; and it is certain that the nyctalopic affection referred to throughout the Hippocratic writings is night-*blindness*. Moreover, Galen, in his lexicon of Hippocratic terms, defines a nyctalope to be one who is blind at night (ὁ τῆς νυκτὸς ἀλαός). It may be added that the restoration of nyctalopia to its signification of night-blindness, advocated in the first issue of this work, has since been adopted in the Nomenclature of the Royal College of Physicians of London.

Though night-blindness is at all times merely a symptom manifested in several diseases, it is convenient to classify it as *symptomatic* when associated with certain appreciable morbid changes in the fundus oculi; and *idiopathic* or *essential* when unaccompanied by such changes.

Of *symptomatic nyctalopia*, by far the most common concomitant is retinitis pigmentosa. It may occur in connexion with detachment of the retina, with syphilitic and other forms of retinitis and choroiditis, and with some embryological defects or intrauterine diseases of the retina or of the choroid. In all the affections of this group the beginning of night-blindness is insidious, and the course is chronic, the physical condition being some morbid alteration in the percipient and pigmentary layers of the retina.

Idiopathic nyctalopia is usually more or less abrupt in its onset, and due to torpor of the retina, showing itself by deficient adaptation of the retina to feeble illumination; and is an exaggeration of the physiological blindness which temporarily takes place in passing from bright into feeble light. In many instances it follows prolonged exposure of the eyes to intense glare of any kind. This is especially apt to occur in persons who have been insufficiently or improperly fed, or who are suffering malnutrition from any cause. Formerly it was often met with as an early symptom of scurvy, and it still occurs epidemically among the poor in those countries where strict religious fasts are observed. It is also observed in some cases of anæmia, albuminuria, liver-disease with or without jaundice, pregnancy, malaria, and chronic alcoholism. In many cases of idiopathic nyctalopia there co-exists a peculiar form of xerosis of the bulbar conjunctiva. On the conjunctiva opposite the palpebral fissures are scaly oily-looking patches, which, by gentle frictions of the lids, can be whipped into a fine white foam abounding in minute bacilli. The exact relation between the xerosis and the nyctalopia has not been determined. The xerosis may only be an expression of impaired nutrition of the eyeball.

The *prognosis* of symptomatic night-blindness is generally unfavourable; while that of the idiopathic form is more favourable—at least in so far as the associated constitutional and local states may be amenable to treatment.

Treatment.—This must necessarily be determined by the ætiological and associated pathological conditions. Of the symptomatic form the treatment is that of the accompanying retinal or choroidal affection; and of the idiopathic form the treatment will be that of the associated constitutional and local conditions. The eyes should be protected by tinted glasses, shades, or bandages; faults and errors of diet corrected; cleanliness of the lids ensured; and tonics and other regimen and medicaments suited to the special requirements of the particular case must be employed. John Tweedy.

NYMPHOMANIA (νύμφη, the nympha, a portion of the female sexual organs; and μανία, madness).—A form of mental derangement in women, characterised by an insatiable desire for sexual intercourse. *See* Sexual Functions in the Female, Disorders of.

NYSTAGMUS (νυσταγμός; from νυστάζω, I nod).—An involuntary movement of the eyeball, due to clonic spasm of the muscles of the globe. It usually affects both eyes. The movement is generally horizontal, that is, from side to side, and is then called *oscillatory*; but it may be *rotatory*, that is, round the optic axis; or *oblique*, when it is said to be mixed. It may be (*a*) congenital or infantile; (*b*) acquired; or (*c*) symptomatic of cerebral or spinal disease.

O

OBERLAND, The Bernese.—Grindelwald, Gurnigel, Interlaken, Mürren, &c. Cool, bracing, mountain summer climate. *See* Climate, Treatment of Disease by.

OBESITY (*obesus*, corpulent; from *ob*, by reason of, and *edo*, I eat).—Synon.: Corpulence; *Polysarcia*; Fr. *Obésité*; Ger. *Fettsucht*; *Fettleibigkeit*.

Definition.—This term is applied to a general state of disordered nutrition of the body, characterised by an excessive development of the adipose tissue (more especially in those situations where it is normally most abundant, namely, the subcutaneous, subserous, and intermuscular connective tissue), which leads to various disturbances in the bodily functions.

ÆTIOLOGY.—(*a*) **Predisposing causes.** The influence of *heredity* in transmitting the liability to obesity is undoubted, and is a matter of common knowledge. But an examination of the families of fat people appears to show that obesity is indifferently transmitted with rheumatism, gout, and other phases of the uric-acid diathesis, oxaluria, diabetes mellitus, and gall-stones; all which perversions of nutrition are in some manner closely correlated and to some extent convertible. The series form a group to which the name *l'arthritisme* has been given by Bouchard, from the marked prevalence of the joint-affections included under the terms 'rheumatism' and 'gout.' *Sex and Age.*—That excessive corpulence is more common among women than among men is also well known. Several circumstances have been suggested to account for this, such as the menstrual functions of women, pregnancy and suckling, from which fatness often dates, their less muscular activity as compared with men, and their frequently diminished oxidative power, due to poverty of red blood-corpuscles. Age appears to have considerable influence in determining this condition. Under a healthy regimen children get fat from birth, notwithstanding that at the same time the albuminoid ingesta must be largely employed in the construction of the rapidly growing tissues; and hence, at this period of life, the fat and amyloid food-stuffs are the chief sources of the adipose deposit. How frequently are seen children, improperly fed on excess of starchy matter, very fat, whilst their general nutrition is much impaired. A fat child is far from necessarily being a healthy one. At puberty there is frequently a diminution in weight, both relatively to the height and absolutely; but the contrary to this sometimes accompanies the establishment of menstruation, especially if the subject be very chlorotic—that is, with an enfeebled oxygen-carrying blood-power. After the age of forty, particularly in women at the climacteric, the influence of age markedly asserts itself. Even the manifestation of the hereditary tendency may be postponed until that period, and for women to become fat at that time is almost the rule. The perversion of nutrition now under consideration is, in some unknown way, curiously but distinctly associated with the degree of development of the sexual functions, and in an inverse direction. This is very noticeable in eunuchs and animals whose generative organs have been removed, and the part played by the cessation of ovulation has been already mentioned. Even during pregnancy, when ovulation is suspended, it is no uncommon occurrence for the subcutaneous fat to be increased in amount. *Occupations.*—Those compelling a sedentary life undoubtedly favour the development of corpulence, especially if there be hereditary predisposition, together with large eating and alcoholic indulgence. *Race.*—Among certain races obesity appears to prevail, as for instance the Hottentots; and whilst amongst some, such as certain castes of Hindoos, the condition has been highly esteemed, amongst others, as the Greeks and Romans, it was regarded as disgraceful. *Climate.*—Although very fat people are met with in all climates, there appears to be a special tendency to their predominance in low-lying, damp countries, whilst, with certain exceptions, they are less often seen in very hot and in mountainous districts. *Nervous influences.*—Since the nervous system so directly influences tissue-changes, it is not to be wondered at that certain nervous states favour obesity as they do diabetes mellitus, another state of malnutrition; it is of frequent occurrence in hysteria and in idiots. Localised increase of subcutaneous fat has been noticed in neuralgic areas and paralysed limbs, and also in cases of atrophic muscular disease—*lipomatosis neurotica.*

(*b*) **Determining causes.**—Excess of *food* is the first of these to be mentioned. Whilst no doubt a large excess of food may lead to corpulency, it must be confessed that it very often does not do so, and extremely thin men are often large eaters. And, on the contrary, many women who become excessively obese have poor appetites. It has been estimated by Bouchard that 40 per cent. of the obese are large eaters, and that 10 per cent. eat less than the normal quantity. Nor does it seem in these different classes of cases that the kind of food makes much difference. Some get fat, eat what they will; others do not, whatever their diet. Nevertheless, starches and sugars are, as a rule, more effective fat-producers than fats. *Drink.*—It is, however, usually the case that very fat people take a large amount of fluid food. How alcohol acts in the production of fat is not very clear. It is asserted that it does so by diminishing oxidation; but this is not the entire explanation, for the extent of obesity is far from being proportionate to the amount taken, and not infrequently an excessive ingestion is not associated with corpulency. There would also seem to be something due to the form in which the alcohol is taken. *Exercise.*—Deficient muscular activity, by diminishing the amount of oxidation of tissue, favours obesity, especially in cases of idleness following on a period of considerable energy, the quantity of food taken remaining the same; and since, as a rule, the stouter the person the less capable is he of exercise, these two conditions react one upon the other, in favour of fat-production. But lack of exercise, like over-feeding, is not invariably followed by corpulence, nor are the two conditions when combined. Bouchard indeed calculates that only 37 per cent. of fat people take too little exercise, and 28 per cent. even exceed the average man in this respect.

Disease.—Exceptional cases of corpulence have followed recovery from severe fevers, and extensive bleedings, even when there had been no predisposition; and a similar result has been met with after prolonged administration of mercurials and arsenic, which is perhaps to be explained by the deteriorating influence that these drugs are said to possess on the red blood-corpuscles.

PATHOLOGY.—Assuming that the current views on lipogenesis, or fat-formation, are known to the reader, it is sufficient here to state that from whatever source the fat of the body be derived, whether from the fatty, the amyloid, or albuminoid elements of the food, or from all, as is most probable, the fact of its being stored up as adipose tissue must be regarded chemically as an expression of deficient or delayed oxidation; a process which, if it had been more complete, would have resulted in the conversion of these elements into carbonic acid and water, to which the fat itself is reduced when it is subsequently used up in the economy. It is thus that the corpulence that frequently attends such morbid states as anæmia, chlorosis, hæmorrhage, some pulmonary and cardiac diseases, and alcoholism, is to be explained; since in all these diseases the oxygenising power of the blood is deficient. Briefly, the causes of obesity may be grouped into those which favour the assimilation by, and accumulation in, the tissues of fat, and those which diminish the combustion of the same; conditions which often co-exist.

The fat of the body in an average male adult constitutes about one-twentieth, and in the female rather more, of the total weight. It is not for 3½ months after the commencement of development that the adipose tissue is sufficiently differentiated to be distinguishable; it gradually increases in amount, being considerable at birth and up to puberty, when it often diminishes slightly; during maturity it increases, or the reverse, being very variable in amount; and during old age it decreases. During childhood the adipose tissue is more evenly distributed in the subcutaneous tissue than in later life, when fat tends relatively to diminish on the surface in proportion as it becomes deeper-seated.

In the three situations in which the fat is chiefly deposited—namely, the subcutaneous, subserous, and intermuscular connective tissue—there are certain areas which are preferred by it, as there are others which escape. Whilst the abdomen, buttocks, breasts, and neck are especially prominent, the wrists, ankles, eyelids, scrotum, and penis are free from fat. Beneath serous membranes it is very unequally distributed. Fat is never seen beneath the peritoneal coat of the stomach or intestines, the parietal pericardium, or the visceral pleura; whilst the great omentum, which usually weighs about ½ lb., may reach to 7 or 8 lbs., or, it is said, even 30 lbs., and a thickness of half an inch or more of fat may be included between the layers of the mesentery. A considerable amount is developed beneath the visceral pericardium; and under the synovial membranes fat may be deposited to such an extent as to interfere with the movements of the joints. Adipose tissue is never found within the cranial cavity, but may be present in large quantity in the spinal canal.

The ordinary state of the organs found in very corpulent people is, that the lungs are small; the heart and the liver large, and infiltrated with fat, the former having the right side dilated with hypertrophy of the left ventricle or atrophy of the entire organ, and the latter showing a state of partial cirrhosis or the nutmeg appearance; the gall-bladder containing only a little pale bile or mucus; the stomach large and muscular, but well-developed and with the intestines often dilated; the kidneys small, as also the spleen and lymphatic glands; and the pancreas largely developed. In extreme cases the blood may contain four to five times the normal amount of fat, sufficient to give it an altered appearance to the naked eye.

Like many other conditions of disease, it is impossible to define the exact line at which a morbid obesity may be said to commence. All degrees of corpulence, indicated by such terms as 'stout,' *embonpoint*, &c., occur, to which the notion of disease is wholly inapplicable. Nor, as will be seen, can the disturbance of function be taken in all cases as the measure of a morbid state, since the impairment of function is not always proportionate to the amount of fat.

As instances of extreme corpulency the following may be quoted:—

Daniel Lambert, who at twenty-three years old weighed 32 st., but could walk from Woolwich to London. His subsequent maximum weight reached to 52 st. 11 lbs. Edward Wright, 44 st. Dr. Wardell records the case of a young married woman, who at eighteen was thin and delicate, had no children, and lived well; she died at the age of forty-one; the thickness of the subcutaneous fat on the sternum was 4 inches, and midway between pelvis and umbilicus 8 inches. The heart weighed 36 oz., the liver 118 oz., and there were prolongations of fat from the omentum 1 to 4 inches long, as thick as a candle. More recently a woman of Baltimore, U.S.A., was stated to scale 850 lbs.

As illustrations of precocious obesity, cases are on record of a girl weighing 13 st. at the age of twelve years; of another aged 11 years weighing 29 st.; and of a boy weighing 8 st. 12 lbs. at three years. This boy had three teeth at birth, and twenty-six at thirteen months old. Infants excessively fat at birth usually fail to maintain their relative bulk after weaning.

Thus, in extreme cases, one-half, or three-fourths even, of the body-weight may be fat.

SYMPTOMS.—The general appearance of a corpulent person scarcely needs description. The condition may be associated either with a hyperæmic or full-blooded, or with an anæmic state of body (the hæmoglobin being deficient in amount rather than the corpuscles too few), and it is desirable to recognise this in view of treatment. Owing to the fatty infiltration of the muscular tissues, and the degeneration of the fibres, the muscular energy is diminished, this being especially noticeable in regard to the heart, the action of which is easily disturbed, and palpitation is a frequent symptom, accompanied by dyspnœa, induced by slight exertion. The affection of the voluntary muscles manifests itself in an indisposition to active exercise. The digestive power is often very well maintained, and this notwithstanding the frequent excess both in the quantity and in the quality of food indulged in. Periodical impairments are, however, frequent; and pyrosis, flatulence, and constipation or diarrhœa, with offensive stools containing much fat, are often troublesome. The cardiac sounds are usually feeble and distant, though the reverse obtains when there is a hypertrophied ventricle. The pulse is very variable, full, or small and weak, according to the plethoric or feeble state of the individual; more or less frequent than normal, irregular or dicrotic, dependent on the degree of fatty change in the heart, or, if of high tension, from fibrosis of the arterioles (*see* HEART, Fatty Growth on). The mental activity is uncertain, and many external causes tend to modify it; but the temperament is proverbially 'easy-going,' indolent, and lethargic, especially after meals, although very frequently interrupted by attacks of peevishness and irritability, or by unusual somnolence and quiet. Examples, however, of considerable intellectual attainments are not unknown among the corpulent. The excretions are usually copious. Profuse sweating is induced by slight exertion, and the secretion of the sebaceous glands is abundant and often fœtid. The urine is generally acid, often diminished in quantity, and contains an excess of uric acid, urates, and frequently oxalate of calcium. Partly from chafing, and partly from the excessive cutaneous secretions, intertrigo and other eruptions are apt to occur in the folds of the groin, below the mammæ, and in similar parts. The vessels share in the general malnutrition of the tissues, and atheroma of the arteries is often found, whilst the veins become distended and varicose, forming hæmorrhoids and varicocele. Some œdema of the ankles is also usual, and hæmorrhages from nose or lungs are not uncommon. Depending upon these vascular changes are the congested and bloated appearance of the face, and the liability to headaches, vertigo, and giddiness. Disturbances of sight and hearing are frequently noticed in fat people. Irregularities of menstruation, which may be early in appearance, are frequent. The sexual appetite is frequently deficient in both sexes, and sterility is common in women: in man it has been attributed to the deposition of fat along the course of the spermatic vessels, causing impaired nutrition of the testes, as shown by the scanty and inactive spermatozoa found in the semen. Accumulation of fat around the umbilical ring favours the occurrence of hernia in this situation, a not uncommon event in the corpulent. The enormous weight of the abdomen causes a constant backache from painful overstrain of the dorsal muscles.

The condition of obesity, like other general perversions of nutrition, most distinctly presents other characteristics than the mere signs and symptoms above enumerated. 'Corpulence is not only a disease itself, but the harbinger of others,' as Hippocrates pointed out. There are certain tendencies and liabilities which the state engenders; and intercurrent maladies come to possess special features. Periodically, the fat man ails without perhaps any obvious cause, and such ailments must be regarded as the expression of malnutrition of the tissues produced by the excess of fat. Among the more prominent of these affections is a proneness to catarrh of the respiratory and alimentary mucous membranes, and periodical 'colds' and diarrhœas are frequent. This is in great part due to the fact that the power of self-regulation of temperature, which the body possesses, is diminished by the thick layer of subcutaneous fat, which is a bad conductor of heat, and interferes with compensatory radiation. At the same time the plethoric condition, and the enfeebled circulation due to the weak heart, tend to the same end, namely, a liability to congestion of the ill-supported tissues, such as the mucous membranes, with the results of such congestion in excessive secretion and other derangements of function.

The obese subject is quite as liable to the acute diseases as is the thin man; and these maladies run in him a singularly unfavourable course. The diminished power of heat-radiation increases the pyrexia; and the weak heart favours the establishment of the adynamic state. Such means for lowering the temperature as cold applications have but little effect through the thick fat; and aconite is contra-indicated by the pulse. But since the oxidising process in the corpulent is diminished, the temperature in the febrile state is rarely very high, and at the same time is but ill resisted.

The effective agent in fat formation, namely, deficient oxidation, also favours the formation of uric acid, and hence the fat are often

gouty. Saccharine urine (a condition which, whatever view be taken of its pathology, is manifestly an expression of deficient oxidation)—especially that form which is met with in those advanced in life—very frequently occurs in stout people, not only in an intermittent form, but constantly with other symptoms of true diabetes mellitus. In 32 of 140 cases of diabetes mellitus observed by Seegen, obesity preceded the glycosuria.

Progress and Prognosis.—The progress of obesity is essentially chronic, and rarely, if ever, tends to other than increase of this state. Extreme fatness in the very young, as already stated, usually subsides; but the obesity of advanced life never does, unless any exhaustive disease should co-exist, such as cancer or diabetes; and the latter by no means produces then the emaciation that it causes in young people. Obesity should, on the whole, be regarded as a grave matter, since very fat people rarely reach an advanced age; whilst a decrease of fat at middle age in a person hitherto stout should be regarded with suspicion.

In obesity, death by syncope may result from an extremely fatty heart; from apoplexy, caused by rupture of an atheromatous vessel in the brain; or from acute pulmonary congestion, with general œdema from cardiac dilatation; whilst rupture of the heart, angina pectoris, and uræmia are among the dangers to which the obese are liable. Not infrequently some sudden exertion has immediately preceded the fatal end.

Treatment.—It is unnecessary even to enumerate the nostrums that a fanciful empiricism has suggested for the prevention or cure of obesity.

Recognising that accumulation of fat is a perversion of nutrition, which, if once established, and with a strong hereditary predisposition, cannot be cured, it follows that we should endeavour to prevent as far as possible its increase, by avoidance of those factors which pathology tells us are favourable to its development. The guides as to how far a given plan may be proceeded with are, first of all, the age and general condition of the patient, especially as regards the heart's power; and, secondly, the feelings and capability of the patient, as the treatment is pursued. Each case must be treated according to circumstances, bearing in mind that the objects to be aimed at are to diminish the sources of the fat, and to increase the oxygen-carrying power of the blood and oxidising power of the tissues.

The diet must be regulated in quantity and quality. Since a healthy diet should consist of certain proportions of nitrogenous, amyloid, and fatty principles, and since from all these three substances fat may be formed in the body, the question arises, which can be most advantageously diminished. Experience supports our pathological knowledge in advocating a withdrawal as far as possible of fatty and more especially starchy food, whilst at the same time a moderate increase in albuminoid matter is permitted; for with a fair quantity of the other food-stuffs, proteids increase tissue-change. It is on this principle that systems of dietary for the corpulent are founded, the best known of which bears the name of Banting, who for a year (1863) successfully followed out a plan laid down for him by Dr. Harvey, with the result of losing 44 lbs. in weight, and without the recurrence of corpulence when ordinary diet was resumed. There are many other cases recorded. Dr. Cheyne, who weighed 32 st., reduced himself a third in weight, and lived afterwards in good health to the age of seventy-two (Dr. Wadd on *Corpulence*, 1822). Lean meats, sweetbread, fish—except rich kinds, such as salmon and eels—clear soups, poultry, game, eggs, cheese, green vegetables, toast, gluten bread, fresh fruit, and pickles are allowable articles of diet. An average diet for an adult would be 12 oz. lean meat, 6 oz. rusks or gluten bread, 4 oz. green vegetables, 1 oz. butter, and 1½ pint tea. If the normal daily requirements be put at—proteids 130 grammes, fats 86 grammes, and carbohydrates 380 grammes (these ingredients being water-free); then the Harvey-Banting diet may be taken as—proteids 170 grammes, fats 10 grammes, carbohydrates 80 grammes. It is necessary that the *régime* be steadily adhered to for a considerable period, and recurred to from time to time when the weight shows signs of increasing. Several well-known modifications of this diet have been proposed. Ebstein's plan was based on—proteids 100 grammes, fats 85 grammes, carbohydrates 50 grammes, with 1,750 grammes of fluid, being an amount of proteids much below the normal, whilst the fats are of the healthy quantity. The deficiency of proteids tends to prevent this diet being pursued for long without loss of strength, and it would be probably more economical if rather less fat and rather more starch were allowed. Oertel's system is characterised by a marked restriction of fluids, the dry proteids being 170 grammes, fats 44, and carbohydrates 114 grammes. The reader will determine for himself how these proportions of alimentary principles may be distributed among various ordinary articles of diet. The exact influence of an excess of water in tissue-metabolism is uncertain, but there is no doubt that a large number of fat people consume an excessive amount of fluid, of which it may not be forgotten that alcohol forms very frequently a considerable proportion, and on such grounds a restricted intake might be regarded as desirable. But whilst cases of obesity associated with anæmia may be benefited by this treatment, it must be admitted that dehydration is attended with great risk in plethoric persons,

especially if the nitrogenous food exceed or even equal the normal quantity, since serious disorders may result from accumulation in the tissues of their products of waste, from lack of fluid to flush them out. Still more is this the case in those extreme methods of dieting which consist of a practically unlimited amount of meat food, with complete abstinence from fats, starches, and sugars; and with such regimen a large allowance of hot water is insisted on. This plan, known as the Salisbury treatment, has been pursued in a modified form by Mr. Towers Smith with considerable success. The fact is that each plan has its merits and can claim successful results, but judgment is requisite in its application to individual cases. All methods compel a very great decrease from the normal of starches, but on each of the other alimentary principles much diversity of practice exists. It cannot, however, be too strongly insisted on that for any considerable increase in nitrogenous food the kidneys must be in a perfectly healthy state, and this should only be permitted in conjunction with a free exhibition of water. Alcohol generally should be avoided, but especially spirits and beer, which must be absolutely forbidden, except on emergency; cider or the light dry wines, both white and red, diluted with water, are less objectionable. Tea and coffee are supposed to interfere with tissue-change, and therefore should be taken sparingly; and milk, from the quantity of fat it contains, is to some extent inadmissible, although a skim-milk diet has been proposed.

Regular exercise, within the limits of the patient's powers, such as riding, walking, rowing, and gymnastics, is of great benefit by directly inducing an increased oxidation of tissue, and improving the quality of the blood, and therefore its oxygen-carrying power. It should form an essential part of every system of treatment, the amount being determined by the state of the patient's heart. Cold bathing, if well borne, is of advantage on similar grounds. Free sweating by Turkish baths is a useful adjunct to dietetic treatment, unless the circulation be enfeebled. Breathing compressed air, with the object of increasing the tissue-oxidation, has been recommended.

It is in carrying out a system rather than in devising one that the difficulty occurs. The regularity and restraint prove irksome to tho patient, and arc frequently brokon. Hence it is that the regimen and spare diet of the various spas, such as Carlsbad, Marienbad, Kissingen, and Ems have great advantages, since at such places, and in such surroundings, the patient more readily and willingly pursues a given plan.

In the treatment of intercurrent diseases, it is essential to remembor the enfeebled resisting powor of the patient, and tho frequent necessity for stimulants.

Among the many drugs that have been usod for obesity may be mentioned alkalis, iron, and iodine. Soap was formerly much omployed, as much as three ounces being given daily with milk and lime water; and some of the good effects of the various 'waters' are ascribed to their alkaline properties, especially the alkaline aperients of the above-mentioned spas. Iron is an essential in those forms of corpulence associated with anæmia, and most satisfactory results follow its administration, as the health improves and the fat diminishes. Young chlorotic subjects benefit by this treatment, which may be advantageously carried out at some chalybeate spring, such as Tunbridge Wells, Harrogate, or Spa. The iodides, such as those of potassium and iron, given in large doses, undoubtedly effect a reduction in the amount of fat, but not always with a corresponding improvement in health. So long as this does not suffer, and the patient improves, the drug may be persevered in, but it is frequently very badly borne when taken in quantity. The preparations of *fucus vesiculosus*, the basis of certain quack remedies, appear to depend for their value on the iodine contained in them. Permanganate of potassium has been recommended on the same grounds that its use is advocated in lithæmia and in glycosuria, namely, to promote oxidation.

W. H. ALLCHIN.

OBLADIS, in the Tyrol.—Earthy saline waters and climatic health resort.

OBSOLESCENT (*obsolesco*, I grow out of use).—A term applied to miliary tubercle, when, instead of undergoing destructive changes, it becomes dried up, shrunken, and hard, and thus remains inert. *See* TUBERCLE.

OBSTRUCTION and OCCLUSION.—Obstruction and occlusion of the different tubes and orifices of the body are mainly effected in threc different ways: first, by *blocking of a tube* by its contents; secondly, by *alteration in its walls*; thirdly, by *pressure from without*.

1. **Blocking.**—The first mode of obstruction is met with in most of the tubes of the body, and may be produced in various ways. The occluding mass may bo composed of the normal contents of the tube; of these contents variously altered; or, lastly, it may be somo foreign substance introduced from without. Examples of the first of theso modes occur in the intestine, in cases of impacted fæces or intestinal concretions; in the biliary and urinary passages from calculi; in the ducts of glands from the products of catarrh or inspissated mucus; and in the blood-vessels from doposits of fibrin. Obstruction by foreign bodies may of course occur in all tubes in dircct communication

with the external surface, but even internal tubes are sometimes obstructed in this manner. As examples of this may be cited the occasional obstruction of the bile-ducts by hydatid cysts, or by the ascaris lumbricoides; of the pulmonary artery by hydatids; of capillaries by masses of bacteria; and of the pulmonary capillaries by air sucked in by a wounded vein.

2. **Parietal Changes.**—Obstruction of tubes from alteration in their walls is the most common cause of the various forms of permanent stricture, and may arise from many different conditions. First, in those tubes whose walls are muscular, it may be the result of spasm. This form of obstruction is usually only of temporary duration, and is probably not of very frequent occurrence. It is supposed to take place in the urethra and the bile-duct, but the most important instances of it are met with in the respiratory and vascular systems. In the former we have examples in spasmodic closure of the glottis, and also in the narrowing of the bronchial tubes in spasmodic asthma; in the latter in the obstruction by spasm of the small arteries of the base of the brain, to which the initial phenomena of the epileptic seizure are ascribed by some. To a similar spasmodic occlusion of the arterioles of the lungs Sir George Johnson ascribes many of the phenomena of cholera. To a more prolonged spasm of the blood-vessels the gangrene of Raynaud's disease, and that produced by ergot, have been attributed.

Obstruction from more permanent alterations in the walls of the tubes may be produced, first, by acute inflammatory swelling and œdema, and by the formation of false membranes; and, secondly, by chronic inflammatory thickenings and cicatricial contractions. These form the non-malignant permanent strictures, as of the urethra, œsophagus, pylorus, and intestines. Thirdly, the growth of some malignant or other tumour in the walls of tubes may lead to the same result. This form of stricture is especially common in the digestive canal, from the pharynx downwards.

3. **External Pressure.**—Lastly, obstruction and occlusion are often the result of pressure from without. This pressure may be exercised by a tumour of some kind, or by enlargement of an organ, as, for example, the obstruction of the trachea produced by an enlarged thyroid body. Or the pressure from without may be produced by the effects of inflammatory processes occurring in the surrounding parts. We have examples of this in occlusion of the intestine by fibrous bands, and in obstruction of the tubuli uriniferi of the kidney by the cirrhotic process. Other examples of pressure from without, causing obstruction, occur in displacements of the intestine in hernia, with which may be classed the various forms of volvulus.

Effects.—The effects of obstruction and occlusion differ, of course, according to the tube or orifice affected. They are in part due to the arrest of function of the tube, and in part are purely mechanical. The most general mechanical effect is dilatation of the tube behind the seat of the obstruction, owing to the accumulation of its contents (*see* Dilatation). When these contents are themselves irritating, or when the disturbing cause also constricts the blood-vessels, ulceration or gangrene and perforation are liable to occur. The other effects are mainly due to the backward pressure of the accumulation. In cases where the tube is the duct of a gland, the ultimate effect is to arrest the secreting function, and cause atrophy of its substance. This is attended by cessation of any further accumulation; and sometimes complete absorption of the previous accumulation takes place, and the dilated duct shrinks and becomes completely atrophied. Examples of this series of changes occur not infrequently in the ureter and kidney. W. Cayley.

OCCUPATION, Ætiology of.—*See* Disease, Causes of; and Public Health.

ŒDEMA (οἰδέω, I swell).—Synon.: Fr. *Œdème*; Ger. *Œdem.*—A dropsical effusion in cellular tissue, whether subcutaneous, submucous, subserous, or in the interstices of organs. *See* Dropsy.

ŒSOPHAGUS, Diseases of.—Synon.: Fr. *Maladies de l'Œsophage*; Ger. *Krankheiten der Speiseröhre.*—The diseases of the œsophagus may be considered in the following order: (1) Œsophagitis; (2) Ulceration; (3) Dilatation; (4) Stricture; and (5) Morbid Growths.

1. **Œsophagitis.**—Definition.—Inflammation of the œsophagus.

Ætiology.—Inflammation of the œsophagus, arising in its structures and confined to it, is an affection of rare occurrence; or it may be that it offers so few marked symptoms that but small attention is paid to it, and it never comes before the physician. But by no means uncommon is the extension of inflammation to the œsophagus from neighbouring structures. Thus, a catarrhal inflammation of the throat and fauces may pass down the œsophagus. In children thrush has been seen to extend into the gullet, setting up a certain amount of inflammation; and the same holds good with regard to diphtheria and croup. Where organic disease of this tube exists, a certain amount of inflammation is liable to be set up. But by far the most common causes of acute œsophagitis are the ingestion of irritating or corrosive substances, such as boiling water, alkalis, or acids; and mechanical injury from the introduction of foreign bodies.

Symptoms.—Somewhere in the line of the œsophagus, pain, varying in intensity, of a

burning or lancinating character, is complained of, at times so severe as to induce vomiting. This pain is rendered intensely acute by all attempts at swallowing. Even the passage of the saliva is sufficient to set it up, and hence it is that this fluid is seen dribbling from the mouth of the child who is the subject of this disorder. Thirst is a usual accompaniment of œsophagitis; but rather than endure the agony of swallowing fluids, the individual will put from him all fluids, however bland. If the attendant insist upon an effort being made to swallow some sustenance, most usually this is speedily rejected, accompanied with much viscid mucus, flakes of lymph, membranous shreds, and sometimes blood or pus. The amount of fever and constitutional disturbance is in proportion to the intensity of the inflammation.

Prognosis.—If simple, acute œsophagitis usually terminates in resolution, and somewhat speedily. If it be due to the passage of acrid or hot substances, ulceration of the œsophagus may result; or simply a permanent thickening of the coats of the tube, whereby its calibre is reduced, and stricture is the result.

Treatment.—It is best to abstain from all attempts to give nourishment in the ordinary way, and to rely entirely upon nutritive enemata till the acuteness of the affection has passed. Ice may, however, be given to the patient to suck, if it prove agreeable to him. For the relief of the pain warm poultices may be applied externally, or opiate fomentations; cocaine lozenges, $\frac{1}{6}$ gr. in each, may be sucked. Opium may be administered either by enema, or subcutaneously. The state of the bowels must be attended to.

2. **Ulceration.**—Ætiology.—This affection, as we have already seen, may arise as the result of the passage of irritating fluids through the œsophagus. More commonly it is brought about by the swallowing of certain pointed or angular bodies which stick in the gullet, and cannot be dislodged; or which, before their removal, have eroded the mucous membrane and produced ulceration. Simple ulcer and perforating ulcer of the œsophagus have also been described; they are similar to those which are observed in the stomach, but are of rare occurrence.

Symptoms.—These are similar to the phenomena described under œsophagitis, only the pain is more localised, and is more generally referred to a circumscribed spot between the scapulæ in the back, at the top of the sternum, or in the præcordia. The same difficulty in swallowing is experienced, and, on account of the slowness of the ulcerated surface to heal, is much more protracted, so that the patient emaciates rapidly, and death from starvation has even been known to occur. Hæmorrhage occurring in the act of vomiting or expectoration is highly suggestive of ulcer. In the perforating variety a communication may be established between the œsophagus and one of the bronchi—more likely the left, the pleura, or the pericardium. Auscultation may reveal a change of tone in the sound of the swallow, it being more dead in quality than in health. The bolus swallowed seems also as if it were diminished in bulk, but much elongated, so that it takes longer to pass the ulcerated spot than it does at any other portion of the tube.

Prognosis.—This must be founded on the nature of the ulcer, but it is always serious.

Treatment.—Not much reliance is to be placed upon medicinal treatment. The patient's strength must be sustained by the liberal use of generous diet if he can swallow, or by nutrient enemata. It may be possible to pass into the stomach a small-sized œsophageal tube (catheter No. 15) and thereby introduce plenty of nourishment. Stimulants will also most likely be called for. Ice may be freely allowed. Local application of nitrate of silver, tannic acid, carbonate of bismuth, borax, cocaine, and other agents, by means of bougies, has been advised.

3. **Dilatation.**—Dilatation may affect the œsophagus in its entire length, but more commonly involves merely a portion of the tube, as is frequently observed in cases of stricture of the œsophagus, which in almost every case precedes this condition. In addition to this, sacs are met with in the walls of the canal, which communicate with it. These diverticula are usually formed by the distension of all the coats of the œsophagus, but sometimes by the mucous membrane alone becoming dilated, and pushed between the other coats. The *causes* which give rise to this condition, in addition to stricture, are the lodgment of some foreign body in the walls of the œsophagus (this is one of the most frequent origins of the diverticula), and paralysis of the walls induced by chronic inflammation.

Symptoms.—These are not marked. If the dilatation be idiopathic, and involve the whole length of the tube, nothing very abnormal will be present to lead to the discovery of this condition. If it be secondary, dependent upon stricture, then, in addition to the symptoms described under that head, it will be observed that the food, after it has been swallowed, is much longer retained than formerly. There is also experienced a sensation of fulness, which may sometimes be perceptible to vision, at the point above the stricture, and this is accompanied by regurgitation of the food into the mouth, initiating in this way a habit of chronic rumination; or there is experienced a desire to relieve the sensation by vomiting, which sooner or later occurs, spontaneously or induced by the patient himself, and affords great and immediate comfort. In the case of diverticula, when of some size, the symptoms are very similar to those above described. In addition, it may

be noticed that a very bad odour is given off from the mouth of the patient, due to the retention and decomposition of the food in these pouches. According to their site, tumours, varying in size as the individual has more or less lately been partaking of food, may be observed. These may sometimes interfere with respiration, deglutition, or circulation. Auscultation in the case of simple dilatation indicates that no obstruction to the passage of the bolus exists, and there is no prolongation of the time it takes to pass into the stomach. But an alteration in the vigour of the peristaltic action is observed. There is a deficiency or entire loss of the contraction of the muscles, and the gradual transmission of the bolus onwards is no longer heard, but it appears to run or drop at once into the stomach. It is generally believed that men are more subject to this affection than women; and it is met with in the decline of life.

Treatment.—Treatment is of no avail for simple dilatation of the œsophagus, except to remove the cause, if possible, and to treat symptoms. In reference to the treatment of diverticula, *see* Memoir by Mr. Butlin, *Royal Med.-Chir. Trans.* vol. lxxvi. 1893.

4. **Stricture.**—This affection may be the result of either of the two first-named disorders; or of a changed condition of the walls of the œsophagus, brought about by the existence of a new-growth, such as cancer, or syphilis. Further, contraction of the œsophagus may be due to the presence of a tumour or other growth pressing upon, and so narrowing its calibre. Or, finally, it may be simply functional, giving rise to temporary obstruction, known as *spasm* (*œsophagismus*) and functional *paralysis* of the œsophagus.

Symptoms.—*Organic* stricture of the œsophagus may have existed for some time before the gravity of the complaint is realised, because the symptoms develop themselves only gradually. The most noticeable is the difficulty in swallowing. At first this may be merely occasional, and only perceived when an effort is made to pass a tolerably large bolus down the gullet; but gradually the difficulty increases, and it is now not only confined to the attempt to swallow solids, however finely masticated, but semi-solids give rise to a sensation as if the food never passed a certain point, this point being usually referred to the manubrium sterni, where the stricture is situated. If the patient, by dint of resolution and perseverance, overcome the difficulty to such an extent as to swallow some food, the first morsel passed being always the greatest trial, it may be retained for a time, but is ultimately rejected. This desire to get rid of the food swallowed increases to such an extent, that all aliment is regurgitated, rather than vomited. The rejected matter consists of the food, little altered, mixed with mucus, or sometimes with a little blood and pus. The reaction is always alkaline. Finally the dysphagia becomes so marked that even the attempt to swallow liquids is given up as hopeless. Coincident with the advance of this dysphagia does the emaciation progress; the abdomen falls in; and the patient dies from starvation. The passage of a bougie will definitely settle any doubt as to the existence of an organic stricture, besides affording information as to its site, extent, and form; but the operation must not be performed without due consideration, as it has happened that an unrecognised aneurysm has been accidentally ruptured by the passage of an instrument. Auscultation will also aid in the diagnosis. It will reveal the same slowing of the passage of the bolus already referred to, and the same elongation of it. In addition, if the stricture be very narrow, then the food will be heard to pass through it with difficulty and with a creaking sound; while if it be narrower still, particularly if the food be fluid, 'it eddies as it were in a funnel, with a prolonged resonant gurgle,' as described by Dr. Allbutt.

Spasmodic stricture of the œsophagus (which is merely a temporary clonic contraction of the muscular coat) differs from the organic form in the suddenness with which the dysphagia comes on; its paroxysmal nature; its not infrequently being but one of the many symptoms of hysteria; its occurrence in young anæmic females, or hypochrondriacal men; and though dyspepsia may be complained of, and even prove an exciting cause, still emaciation does not exist. The point where the impediment to the passage of the food is experienced is usually at the upper part of the œsophagus or pharynx. Occasionally pain is complained of on attempting to swallow, and food taken is sometimes ejected. But the spasm soon yields, and food finds it way into the stomach. The difficulty in swallowing is much increased by the attempt being witnessed by sympathising friends, and a stern command to cease from such frivolous efforts often succeeds, to a surprising degree, in overcoming the dysphagia. On introducing a bougie, it will of course be stopped if the spasm exists at the moment; but gentle, careful, continuous pressure will ultimately cause the spasm to give way, and thus its true nature will be revealed.

Prognosis.—The prognosis in cases of real organic stricture cannot be otherwise than always grave. If it be due to cancerous growth, then it must necessarily be most unfavourable. Spasmodic stricture is very hopeful.

Treatment.—The treatment appertains more to the domain of surgery than of medicine. In the case of organic stricture, the frequent passage of bougies of varying size often proves valuable, except in the case of

cancer, when it should never be attempted. Diet must be attended to, the state of the stomach looked to, and dyspeptic indications combated. If food cannot be swallowed, a small catheter may be introduced through the stricture, and the patient fed by the stomach-pump; or nutrient enemata may be administered. For the spasmodic variety, the general system must be treated, tonics prescribed, and the usual anti-hysterical remedies ordered.

5. **Morbid Growths.**—By far the most common form of growth in the œsophagus is cancer. Occasionally fibroid tumours are seen, either as such, or as polypi, situated about the level of the cricoid cartilage. When carcinomatous, the growth may be any of the usual varieties of cancer, but most commonly it is the pavement-cell epithelioma which invades this organ. It will occasionally be found to affect the upper third, much more commonly the lower third, and very rarely the middle of the gullet. It commences in the submucous tissue, speedily involving the other coats of the tube. From this it may extend to other organs, and perforation of the trachea, bronchi, aorta, or pericardium may take place.

Symptoms.—Confining the attention to cancer of the œsophagus, this disease may well be suspected if, in an individual above middle age, gradually increasing dysphagia be complained of; if symptoms of stricture be pronounced; if pain be experienced, especially of a lancinating character, about the spine and shoulder-blades; if nausea and retching be observed, together with irritating cough, and occasional hiccough; if the patient continue to emaciate, and present the dirty greenish-yellow complexion common in cancerous cachexia, together with enlargement of lymphatic glands; and most certainly shall we be confirmed in our diagnosis if, on examination of the vomited matters, cancer-cells or nests of epithelial cells be seen.

Prognosis.—The prognosis is of the worst description. The patient gradually becomes exhausted, and dies of inanition.

Treatment.—Treatment can be merely palliative. It consists in relieving the pain by anodynes; and endeavouring to sustain the patient's strength as long as possible, most successfully by the use of peptonised nutrient enemata. To prolong life, the aid of the surgeon may be called in, either to dilate the stricture by catheters, or to perform gastrostomy. Œsophagotomy will probably be out of the question.

Claud Muirhead.

ŒSTRUS (*οἶστρος*, a gadfly).—Synon.: Fr. *Œstre*; Ger. *Bremse.*—A genus of dipterous insects, called gadflies, the larvæ of which, vulgarly known as maggots or bots, live parasitically in man and animals. The ordinary human bot, *Œstrus hominis*, is of rare occurrence in England, but is not infrequently met with in warm countries, especially in South America. The larva of the gadfly of the ox, *Œstrus bovis*, also occasionally attacks man.

True maggots and other bot-like larvæ are occasionally encountered in medical practice. The late Dr. Livingstone, when in Africa, was attacked in the leg by a small bot-like larva, which Dr. Kirk removed by incision. The specimen is now preserved in the museum of the Royal College of Surgeons of England.

OEYNHAUSEN, or REHME, in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

OFEN, in Hungary. — Sulphated waters. *See* Mineral Waters.

OÏDIUM ALBICANS. — Synon.: *Saccharomyces mycoderma*; *Mycoderma vini* (Grawitz).—A vegetable parasite, associated with thrush. *See* Mouth, Diseases of.

OINOMANIA (*οἶνος*, wine; and *μανία*, madness).—A synonym for dipsomania. *See* Dipsomania.

OLD AGE, Signs of.—*See* Senility.

OLFACTORY NERVE, Morbid Conditions of.—The principal morbid conditions that occur in connexion with the nerve of smell are the following: (1) Hyperæsthesia; (2) Subjective Sensations of Smell; (3) Perversion of the Sense of Smell; and (4) Olfactory Anæsthesia.

1. **Olfactory Hyperæsthesia.**—Synon.: Hyperosmia.

Definition.—Increased sensitiveness of the olfactory nerve.

Ætiology and Symptoms.—This condition is seen in the increased nervous sensibility which results from chronic debilitating illness. It occurs also in hysteria, in which remarkable, almost animal, acuteness of the sense is sometimes present, so that not only objects but persons have been discriminated by this means. In insanity the same condition is sometimes met with. It is usually associated with, and has to be distinguished from, an altered appreciation of odours, shown in the abnormal enjoyment of or disgust at the odours which are recognised with natural or preternatural acuteness.

Treatment.—The condition rarely calls for special treatment.

2. **Subjective Sensations of Smell.**—Subjective sensations of smell occur from central disease, or from irritation of the nerve of smell. In the insane, olfactory hallucinations occur, though less commonly than those of the visual or auditory sense. Schlager met with them in five cases out of six hundred. In epilepsy subjective sensations of smell occur as occasional prodromata

of fits, and the disease in these cases probably involves the olfactory centre in the anterior part of the temporo-sphenoidal lobe. It was so in a case of tumour recorded by Sander. Irritation of the nerve, from meningeal disease or injury, also, in rare cases, causes olfactory hyperæsthesia. Persistent disagreeable smells are occasionally complained of after influenza. Sir Richard Quain has recorded an interesting case of perityphlitis, in which an apparently subjective sensation of a foul odour was persistently complained of by the patient, until evacuation of the contents of the abscess, when the supposed smell completely disappeared.

3. **Perversion of the Sense of Smell.** Synon.: Parosmia.—This is a rare condition which occasionally results from irritation of the nerve or central organ. In a case recorded by Legg, some time after an injury to the head all substances 'tasted' of gas or paraffine, and there was marked diminution in the acuteness of the sense of smell.

4. **Olfactory Anæsthesia.** — Synon.: Anosmia.

Definition.—Loss or diminution of the sense of smell.

Ætiology. — The causes may be local changes in the organ of smell; disease of the nerve; or disease of the centre.

(*a*) Among *local* causes may be mentioned the following: (1) Acute and chronic catarrh of the olfactory mucous membrane, the latter causing thickening—a condition sometimes produced by excessive snuff-taking. A large proportion of the cases follow severe and prolonged catarrh, and are due purely to the local effect on the tissues through which the olfactory nerve-endings are stimulated. (2) Dryness of the mucous membrane, as in cases of destruction of the external nose (Notta), or in paralysis of the fifth nerve. (3) Occlusion of the passage by polypus, preventing the access of air to the olfactory region. (4) Impaired access of air consequent on facial paralysis. The loss of the power of dilating and keeping expanded the nostril prevents a due quantity of air being drawn through the nasal passage; and, moreover, the loss of power of compressing the nostril in 'sniffing' prevents the air being directed into the olfactory region. (5) In rare cases loss of pigment in the nose, consequent on general loss of pigment, has appeared the cause of loss of smell.

(*b*) *Damage to the olfactory nerve* may result from injury or disease. It is not an uncommon result of blows or falls upon the head, and it is probable that in these cases the delicate olfactory nerves are lacerated as they pass through the bone, or may even be torn from the bulb (*see* Nose, Diseases of). The bulb, or tract, may also suffer in adjacent disease, as tumour, abscess, caries of the bone, and meningeal changes, especially syphilitic. Spontaneous atrophy of the olfactory bulbs occasionally occurs in old age, and has been met with in younger persons, and (rarely) in tabes dorsalis. Excessive stimulation of the nerve by a very powerful odour has been followed by anosmia.

(*c*) In *cerebral disease* the sense of smell is sometimes lost. It may be impaired in so-called functional disease, as in hysteria, and in degenerative disease, as paralytic dementia. It is occasionally lost in organic disease involving the roots of the olfactory nerve. Unilateral anosmia has been met with in cases of aphasia (Hughlings Jackson), an association which is explained by the passage of the external root of the olfactory nerve past the island of Reil to the anterior part of the temporo-sphenoidal lobe. Together with the other special senses, loss of smell has been observed on the side opposite to a lesion near the posterior extremity of the internal capsule in the opposite hemisphere.

It is to be remembered that the olfactory nerves are sometimes congenitally absent.

Symptoms.—The evidence of anosmia is the loss of the perception of odours and flavours—the former term being applied to the sensation when its cause enters by the anterior nares, the latter when it enters by the posterior nares and the sensation is blended with that of taste. It is generally imagined that flavours are tasted, and hence those who are suffering only from anosmia are said to have lost smell and taste. The loss of the olfactory sensation may be partial or complete, according to the extent of involvement of the nerves. In some cases, especially of traumatic origin, the ability to perceive one or two odours may be unimpaired, no others being recognised. It may be lost on both sides, when due to degenerative changes; or on one side only, from local changes or injury or brain-disease. When due to organic brain-disease, it is generally lost on the side of the cerebral lesion. Unilateral loss, in hysterical hemianæsthesia, occurs on the side opposite to the hemisphere which is in a state of partial inhibition; and a similar loss, with that of the other special senses, has been met with in rare cases of organic disease.

Diagnosis.—The diagnosis presents little difficulty. In examination, care must be taken to employ only substances—as aromatic oils, &c.—which affect the olfactory nerve, and not acrid substances, as ammonia and acetic acid, which stimulate also the fifth nerve.

Prognosis.—The prognosis in anosmia is favourable when it is due to a local cause which has existed but a short time, or in which its cause (such as obstruction from a polypus) can be removed. Prolonged changes in the mucous membrane of the nose seldom pass away sufficiently to permit restoration of smell; and whenever there is reason to suspect injury or disease of the olfactory

nerve or centre, recovery is very improbable. Hence traumatic loss of smell, which has continued for some months, will certainly persist.

Treatment. — Anosmia, as a symptom, rarely calls for treatment, which should be directed to its cause. Sometimes local stimulation is of service; and occasionally counter-irritation, by blisters to the neck, has appeared to assist recovery. In hysterical cases faradisation of the nasal mucous membrane has been recommended; but the olfactory nerve itself is not accessible to electrical stimulation. The chief therapeutical measures are those for the treatment of the nasal mucous membrane. *See* Nose, Diseases of.

W. R. Gowers.

OLIGÆMIA (ὀλίγος, small; and αἷμα, blood).—Deficiency of the total amount of blood in the body. *See* Blood, Morbid Conditions of.

OMAGRA (ὦμος, the shoulder; and ἄγρα, a seizure).—Synon.: Fr. *Omagre*; Ger. *Schultergicht.*—A name for gout in the shoulder. *See* Gout.

OMENTUM, Diseases of.—*See* Peritoneum, Diseases of.

ONANISM (Onan).—A synonym for masturbation. *See* Masturbation.

ONYCHIA (ὄνυξ, the nail).—An inflammatory affection of the matrix of the nail. *See* Nails, Diseases of.

ONYCHOGRYPHOSIS (ὄνυξ, the nail; and γρυπός, curved).—This term is applied to curvature of the nails; and, more particularly, to the oblique elevation of the nails from their matrix by the accumulation beneath them of crude cell-substance, which forms a kind of wedge, and crumbles away upon desiccation. *See* Nails, Diseases of.

ONYCHOMYCOSIS (ὄνυξ, the nail; and μύκης, a fungus).—Parasitic disease of the nails. *See* Tinea Tricophytina; Favus; and Nails, Diseases of.

OPHTHALMIA (ὀφθαλμός, the eye).—Synon.: Fr. *Ophthalmie*; Ger. *Ophthalmia.* A general term which might be used to express any morbid condition of the eye, but which is restricted by custom to the forms of inflammation which originate in the superficial structures of the organ, such as the varieties of conjunctivitis, or the phlyctenulæ which sometimes appear upon the cornea and may give rise to shallow ulcers. Thus we have mention by authors of *infantile, catarrhal, contagious, purulent,* and *strumous* or *phlyctenular*, ophthalmia. *See* Eye, and its Appendages, Diseases of.

OPHTHALMITIS (ὀφθαλμός, the eye). Synon.: Panophthalmitis; Fr. *Ophthalmite*; Ger. *Augenentzündung.*—A term which has been used to express inflammation affecting the whole of the structures of the eyeball, superficial as well as deep. Such a condition is most frequently seen after operations upon the eye, and was described by the late Dr. Jacob as *eyeballitis*! *See* Eye, and its Appendages, Diseases of.

OPHTHALMOSCOPE (ὀφθαλμός, the eye; and σκοπέω, I examine).—Synon.: Fr. *Ophthalmoscope*; Ger. *Augenspiegel.*

The ophthalmoscope is an instrument for lighting up the interior of the eye, in such a manner as to render the contained structures clearly visible.

Description.—The first ophthalmoscope was invented about 1847, by the late Mr. Charles Babbage, who laid it aside because an ophthalmic surgeon to whom he showed it, and who failed to perceive its probable utility, afforded him no encouragement. In 1851 another form of the instrument was invented by Helmholtz; but, in 1852, Babbage's original form was re-invented by Ruete, and this, with a few unimportant modifications, has ever since held its ground in practice. It consists, essentially, of a slightly concave mirror, with a small central perforation; or, if the mirror be of silvered glass, with the silvering removed from a small circle in the centre. A mirror the size of a shilling is large enough for most practical purposes, and a central aperture of not more than 2 or 3 millimètres in diameter is better than a larger one. The mirror may be attached to a handle of any proportions preferred by the owner, or may be left without one; but it must be accompanied by certain auxiliary convex and concave lenses, the uses of which will be presently explained. The focal length of the mirror is usually about 8 inches.

Method of Use.—In order to learn the use of the ophthalmoscope, the beginner will do well to avail himself of a contrivance called Perrin's artificial eye, or of one of the more elaborate forms of it designed by Landolt and by Frost. The instrument essentially consists of a small hollow sphere of metal, to represent the eye, closed in front by a lens, which can be changed at pleasure, and behind by a door for the insertion of pictures of various healthy and diseased conditions of the retina. When an artificial eye is not available, the learner should take the patient into an obscurely lighted room, and should stand or sit facing him, with the two heads upon the same level. A gas or oil flame—preferably, from its greater steadiness and superior illumination, that of an argand burner—is then placed upon the same level as the eye which is to be examined, on the same side of the head, and a little behind it, so that no direct light shall fall upon the cornea. The observer, commencing with his face exactly opposite that of the patient, and about eighteen inches distant from it, places the back of the ophthalmoscope mirror against his eye, using preferably that which

is opposite to the eye to be examined, the right eye for the patient's left, and *vice versâ*. The patient is directed to look as if at a distant object, over the shoulder of the observer which is most remote from the eye under inspection, thus looking over the observer's left shoulder when the right eye is being examined. In this position, the observed eye is turned a little towards the nose; and the optic nerve-entrance, which is somewhat on the nasal side of the posterior pole, is brought opposite to the pupil. Looking through the mirror-aperture, the observer directs the light of the flame, reflected from the polished surface, in such a manner that it falls into the pupil of the observed eye; and this light, returning from the eye, reaches him through the perforation. It exhibits the cavity of the eye illuminated, but, as a rule, shows no objects, but only the pupil as a reddish or yellowish circle. In order to see the contained structures, two methods are employed, the *indirect* and the *direct*; the former of which gives the better general view of the fundus, the latter the greater facilities for studying the condition of single points on the nerve or on the retinal surface. It is therefore necessary to be conversant with both, and to use one or both as circumstances may require.

Indirect Method.—In using the indirect method, the observer takes a biconvex lens, of about two inches focal length, and holds it with his free hand in the track of the returning light, and at about two inches from the eye of the patient. The rays of light, thus rendered convergent, become united into an aerial inverted image of the fundus of the eye, which image, and not the fundus itself, will be the object of vision to the observer. The position of the image is in the focal plane of the lens, on the side next the spectator; and, in order to see it clearly, nothing is necessary but to have the observing eye in the track of the returning rays, and at the right distance from the image; which, it must be remembered, with a two-inch lens, will be four inches or more nearer to the observer than the eye of the patient. The whole art of using the ophthalmoscope for the indirect method may be said to consist in moving the eye to and fro upon the line of sight until the right distance is attained, without moving it laterally so as to get out of the track of the rays, and without losing the illumination. As soon as a vessel, or any other defined object, is seen, the observer knows that his distance is correct, and he then causes the patient to change the direction of his eye until every part of its fundus has come successively into view. The image, it must be remembered, is inverted in every particular; its nasal side representing the temporal side of the retina, and its upper portion the lower portion of the retina. In first attempts to use the ophthalmoscope it is desirable to have the pupil of the observed eye dilated by atropine or duboisine, but, after dexterity has been attained, the dilatation may in most cases be omitted. The details of the retinal image are sometimes more or less obscured by an image or images of the lamp-flame; of which there may be two, one formed by the anterior and one by the posterior surface of the lens. These images are only sources of embarrassment when the lens is held vertically, and may be displaced and put out of sight by giving it a small degree of obliquity. A bright image of the mirror itself upon the retina, showing the central perforation as a dark spot, is sometimes troublesome to beginners; and it is said that this image has even been mistaken for that of the optic nerve. The blackness and sharp definition of the perforation should render such a mistake impossible; and the image may readily be displaced by a slight alteration of the angle at which the mirror is held.

In order to magnify the inverted image, and to increase its brightness by bringing the mirror nearer to the eye of the patient, a convex lens may be placed behind the mirror for the observer to look through. Something of this kind is always necessary for observers who have reached the period of life at which spectacles are required for reading; and it is advantageous to all persons. The writer's practice is to use a lens of about seven inches focal length in this manner; and there is thus obtained an image which for many purposes is as good as that afforded by the direct method. With such a lens, the eye of the observer can be only seven inches from the image, and, as this will be formed four inches in front of the eye of the patient, it follows that the two faces will be only eleven inches apart. At this comparatively small distance, the illumination of the fundus of the observed eye, which is afforded by a good mirror, is exceedingly satisfactory.

Direct Method.—In the direct method, the observer does not apply any intervening glass between the mirror and the eye of the patient, but comes as close to the latter as possible, and looks, not at an aerial optical image, but at the actual fundus itself, magnified by its own crystalline lens. It is only when the eyes of both observer and patient are of normal refraction, or emmetropic, that this can be done without the aid of a lens, which when required is most conveniently placed behind the mirror. The lens employed for this purpose must be such as to correct the sum of the error of refraction of both the eyes; and must therefore be concave when this error is on the side of myopia, convex when it is on the side of hypermetropia. An observer who is short-sighted will begin his investigation with a concave lens behind his mirror, which corrects his own short sight; and he will add to or diminish the power of

this lens to meet any degree of ametropia which the observed eye may present in addition to, or in diminution of, his own. In order to facilitate the required changes, all necessary lenses are now usually mounted upon a revolving disc placed behind the mirror, and so arranged that each one of them can be brought in turn before the aperture. In one of the best of the modern forms of instrument, that of Dr. Loring of New York, the mirror itself is made to turn upon pivots in a vertical line independently of the disc of lenses, so that the correcting lens receives no obliquity from the position of the mirror. This contrivance is valuable in some cases, especially when a correcting lens of high power is required, because such a lens, if held obliquely, is liable to produce some distortion of the objects seen through it. In using the revolving disc, a normal-sighted observer commences with no lens behind the aperture ; and, if he then obtains clear definition, he knows that the eye into which he is looking is normal-sighted also, or at most is only in a slight degree hypermetropic. If, on the contrary, he does not obtain a clear image, he knows that the eye into which he is looking, unless the transparency of its media be impaired, is not normal-sighted, but that it is either myopic, or hypermetropic in a somewhat high degree. Keeping the fundus in view, he causes the disc to revolve until a lens comes over the aperture which renders the picture distinct; and he has then only to see the number and kind of the lens in order to know the degree as well as the nature of the defect of refraction. In many cases it is even possible to prescribe spectacles, as the result of such an examination, with a very fair degree of correctness and success. But the chief use of the direct method, especially in the applications of the ophthalmoscope as an instrument of diagnosis in general medicine, is to scrutinise, as already stated, some portion of the fundus of the eye which has been shown, by the indirect method, to require more minute examination than that method will itself permit the observer to accomplish.

OPHTHALMOSCOPIC APPEARANCES.—In order to interpret ophthalmoscopic appearances, and to distinguish physiological variations from pathological changes, it is before all things necessary to bear in mind the anatomy of the structures which are, or may be, rendered visible, and the relations which they bear to each other. The fundus of the eye is composed of several layers, the more anterior of which commonly conceal the posterior; and conceal them in such a manner that, when the former are rendered more transparent by malformation or disease, the latter are brought into view.

1. *Sclerotic.*—Commencing with the posterior layer, it consists of the inner surface of the sclerotic, a smooth and shining white surface, which is ordinarily entirely concealed by the pigmentation of the choroid and of the posterior or epithelial layer of the retina. The sclerotic is naturally visible, as a general white background to a vascular network, in cases of albinism, in which the natural pigment of the eye is congenitally absent, or in some very fair persons, who are not albinos, but whose eyes are very sparingly pigmented. It is rendered visible in patches, as a result of malformation or disease, in cases in which it is exposed by a fissure through the choroid, such as generally accompanies *coloboma iridis*; in cases in which the choroid has suffered atrophy as a result of antecedent hæmorrhage or inflammation; and in the immediate neighbourhood of the optic discs, in the so-called crescents of choroidal atrophy which are so often associated with high degrees of myopia. The whiteness of an exposed sclerotic may be distinguished from that of an opaque white deposit in the choroid or in the retina, by many small physical characters, such as the relation of the borders of the whiteness to the neighbouring tissues and vessels, which will show the one to be the result of the removal, the other of the addition, of material. The most conspicuous white deposits are those associated with albuminuria or diabetes mellitus, with syphilitic retinitis, and with the first stages of retinal glioma. In all these the deposits manifestly cover and conceal vessels, which may be seen to emerge from beneath them; while in complete atrophy of portions of the choroid, it is not uncommon to see a few remains of dwindled vessels, and other shreds of choroidal tissue, rendered unusually conspicuous by their white background, and manifestly situated in a plane anterior to it.

2. *Choroid.*—The next layer from behind forwards is the choroid, which is essentially a vascular network, containing more or less pigment in the intervals between the vessels. In very fair eyes, as already mentioned, the choroid may allow the general whiteness of the sclerotic to shine through; but, in the great majority of cases, it conceals the latter entirely. In like manner, the actual structure of the choroid is itself usually concealed by the pigment in the epithelial layer of the retina; and the choroid generally only plays the part of a red background, varying up to dark chocolate colour in very dark eyes, and exhibiting neither structure nor vessels. When the retinal epithelium is scantily pigmented, as occurs in light eyes, the larger choroidal vessels may be seen through the retina; and they are readily distinguished from those proper to this structure by their different arrangement; the vessels of the retina being arborescent, whilst those of the choroid are either nearly parallel to one another, or arranged in more or less diamond-shaped reticulations. When both sets are visible together, moreover, the vessels of the

retina will be clearly seen to be in a plane anterior to that of the vessels of the choroid, and a variety of minute differences of colour and aspect will suffice to show that the two sets form parts of different circulatory systems.

3. *Retina.*—The retina itself is formed of several layers, the deepest of which contains the perceptive elements, or the rods and cones of the so-called Jacob's membrane. In front of the perceptive elements there are ganglionic and granular layers, subservient to the functions or to the nutrition of the rods and cones; and, in front of these again, a layer of connective tissue, containing and supporting the conducting fibres, which are ultimately massed together in the trunk of the optic nerve, and which convey impressions from the retina to the brain. The fibre layer and its connective tissue are necessarily thickest in the immediate neighbourhood of the optic nerve, and they thin off towards the peripheral parts of the retina; whilst all but the perceptive elements are wholly wanting over a small circle or depression at the posterior axis of the eyeball, a little to the outer side of the nerve, and known as the 'yellow spot,' with its *fovea centralis.* The central artery of the retina enters the eye in the trunk of the optic nerve, and the central vein emerges in the same manner, the circulation between the two being almost a closed one, save for a few very small and insignificant anastomoses of the terminal vessels, some at the nerve-entrance itself, others in the ciliary region. The retinal blood-vessels are chiefly lodged in the connective tissue of the fibre layer, and only small twigs dip down into the deeper retinal tissues. The arteries and arterioles divide, and the veinlets and veins unite, in an arborescent fashion; and the two sets of vessels are readily distinguished apart by the larger calibre and deeper colour of those which carry venous blood. At the nerve-entrance, both sets bend at a right angle, or nearly so, in order to pass from the axis of the nerve-trunk into the plane of the retina, or *vice versâ.*

Between the rods and cones of Jacob's membrane, and the anterior or capillary layer of the choroid, there is a sheet of pavement-epithelium, the cells of which contain a larger or smaller quantity of pigment. This epithelial layer was at one time regarded as part of the choroid, but more recent histologists refer it to the retina. When full of pigment, it forms an opaque screen, by which the choroid is concealed from view, and against which the delicate retinal structures, especially near the nerve, may become apparent as a thin, almost pellucid film, in which blood-vessels ramify. In the eyes of fair people, with only scanty pigmentation, the epithelium neither completely conceals the choroid, nor does it throw up the retina with anything like the same distinctness, so that the retinal blood-vessels are clearly seen, but not the structure which supports them. When the pavement-epithelium has been removed, either by disease or by senile changes, the choroidal tissues become conspicuous.

4. *Optic Nerve.*—The general aspect of the optic nerve varies greatly, within limits defined by differences in the degree of its capillary vascularity, by the effects of contrast arising from the degree of pigmentation of the surrounding parts, and by the mechanical arrangement of the structures of which it is composed. The aperture in the sclerotic, by which the nerve enters the eye, is closed by a cribriform plate of condensed connective tissue, the *lamina cribrosa*; and the fibres normally leave their sheaths on the outer side of this lamina, only the axis-cylinders passing through its perforations. The combined axis-cylinders constitute a mass the whiteness of which is subdued rather than glistening, and which derives a certain amount of reddish, roseate, or pink colour from the capillary vessels by which it is permeated. The axis-cylinders, like the vessels, bend round as they pass from their original direction into that of the retinal surface; and, in the majority of instances, they leave a central depression in the nerve-disc as they separate, a depression at the bottom of which the glistening whiteness of the lamina cribrosa is visible, and which has been called the *porus opticus.* In other instances, this central depression does not exist, but the axis-cylinders are gathered chiefly towards one side of the nerve-entrance, and the lamina is visible laterally instead of centrally. The size of the *porus opticus* is very variable, insomuch that sometimes, when it constitutes quite a large central depression, it is described as congenital or physiological excavation of the nerve. This congenital excavation is always readily distinguishable from the excavation produced by the pressure consequent upon excess of internal tension; because the former never, and the latter always, extends to the extreme margin of the nerve. In other words, the congenital excavation, however large and remarkable, is always surrounded by a ring of nerve-tissue; while the morbid excavation always extends to the margin of the opening in the sclerotic. The position of the blood-vessels in the nerve-entrance is also another variable factor, since they are sometimes nearly central, and at others are seen to pass into or out of the nerve-tissue close to its margin. In a few cases, moreover, the axis-cylinders at some portion or portions of the circumference carry their sheaths for a short distance into the retina; and the nerve is then surrounded by white glistening processes, with brush-like terminations. Sometimes, again, the margin of the opening in the choroid is richly pigmented, and the nerve is surrounded with a ring, or bordered by a crescent, of chocolate or black colour.

5. *Fundus as a Whole.*—The general appearance of the healthy fundus oculi may be summed up somewhat in the following way: The background seen in the inverted image ranges in colour from an almost chocolate tint in very dark people or in the dark races, to a closely woven reticulation of vessels carrying red blood, and affording indications of the white sclerotic lying behind them. In light eyes, the retina itself is invisible; but in dark eyes its thickest portion appears as a delicate film, which has been compared to moistened tissue-paper, over the portion of the field which immediately surrounds the optic nerve. Except in very light eyes, the vessels of the choroid are not individually visible, being concealed by the pigmentation of the pavement-epithelium; and, when visible, they are distinguishable by their parallel direction, and by the absence of branches. The vessels of the retina are always clearly visible, and may be traced along their numerous arborescent ramifications to twigs of extreme fineness. The arteries are smaller and brighter than the veins, and often present the appearance of a white line running along the axis of the vessel, almost as if it were a translucent red tube, carrying a white fluid. The veins, larger and darker than the arteries, seldom display the white line. The vessels pass off the optic disc on all sides, but make bold curves which carry them clear of the region of the yellow spot. In the close vicinity of the disc, the vessels are sometimes attended by fine white threads, pursuing the same general course with them, and which are apparently coarser portions of the connective tissue by which they are sustained. The optic disc, or termination of the optic nerve itself, the most conspicuous object in the ophthalmoscopic image, stands out boldly against its surroundings, and presents a general colour-effect which depends partly upon the richness of its capillary blood-supply, and partly upon the greater or less degree of pigmentation of the tissues around it. Over part of its surface, generally in or near the centre, but sometimes laterally, it displays the whiter colour of the lamina cribrosa, and the mottling of its perforations for the passage of the nerve-fibres. It is often bordered, either entirely or partially, by a line of dark pigment situated at the margin of the choroidal opening; and it often exhibits also a fine white line at its margin, which is the edge of the opening in the sclerotic, seen through the semi-transparent nerve-tissue. The vessels pass over its margin without deviation or change of plane. The apparent size and shape of the disc depend much upon the refraction of the eye. As seen in the inverted image, it appears comparatively small in a myopic eye, and large in a hypermetropic; while, in cases of astigmatism, it is distorted into the appearance of an oval. In the same way, the refraction modifies the apparent actual, but not the relative calibre of the vessels. In the myopic eye the vessels appear of small diameter, and in the hypermetropic they appear of large diameter; so that no conclusions about their actual size can be drawn until the state of refraction has been taken into account. The fact that the veins are relatively larger or smaller than usual, when compared with the arteries, is, of course, not influenced by refraction, except that, in a hypermetropic eye, such a difference would be more conspicuous than in a myopic, by reason of the more magnified image produced by the optical conditions of the media.

6. *Circulation.*—In a general way, the blood-currents in the vessels of the retina are continuous and uninterrupted; but any hindrance to the entrance of blood may be attended by pulsation, first in the veins and subsequently in the arteries. Such hindrance may arise from disordered action of the heart, as in cases of insufficiency of the aortic valves; from disease of the coats of the arteries; or from increased resistance on the part of the fluids already occupying the cavity of the eyeball. The venous pulse depends upon an arrest of the outflow through the veins by the pressure of the entering arterial current; which, at the acme of the pulse-wave, has force enough to push back the venous current when there is not room enough for both. Hence, in the venous pulse, the vessels empty themselves in a direction from the centre of the disc towards its periphery, and refill in the opposite direction. The ordinary cause of venous pulse is increased tension or fulness within the eyeball, so that it is among the early symptoms of glaucoma; but it is also to be seen in a small proportion of cases in which no excess of tension is to be discovered either by touch or by symptoms, and in which the eyes appear to be healthy. In the arterial pulse, the resistance to the entrance of blood, or rather the disturbance of the balance between the propulsive and the resisting forces, must be considerable; and the course of events is that the arterial current can only make its way into the eye at the acme of the pulse-wave, during which the arteries fill from the centre of the disc to its periphery, to collapse again as soon as the impulse of the systole diminishes. In such a condition, the impediment to the entrance of arterial blood is sufficient to imperil the nutrition of the nerve-tissue; and the writer has seen at least one case of partial nerve-atrophy, attended with arterial pulsation, for which no other cause than excessive arterial tension could be assigned. Arterial pulse is probably always present in advanced stages of glaucoma; but by the time it is produced, the fundus is usually obscured or

rendered invisible by other changes. Apart from glaucoma, its most frequent cause is aortic regurgitation; and in this form the eye does not suffer, except together with other parts of the organism.

7. *Optic Neuritis and Atrophy.*—The morbid appearances seen with the ophthalmoscope, and interesting to the physician, are chiefly those which point to the existence of some diathesis, or to the presence of disease in other organs. Swelling of the intra-ocular extremity of the optic nerve, with obliteration of its margins and obstruction to its vessels, occurs in many forms of intracranial disease, especially in connexion with intracranial tumour, and is often followed by atrophy and blindness when life is sufficiently prolonged. The most interesting characteristic of these cases is that, since the swelling affects only the connective-tissue layer, which is absent over the region of the yellow spot, there is commonly no diminution of the acuteness of central vision until the atrophic changes have commenced; by which time, in many instances, the primary swelling has passed away. Hence, for many years, there existed great uncertainty about the cause of the atrophy, and this uncertainty was only removed when physicians began to examine the fundus oculi in all cerebral cases, without regard to the state of sight. Prior to that time, the intra-ocular changes were apt to remain undiscovered in their primary stage, and until commencing impairment of vision produced resort to an ophthalmologist, followed by an ophthalmoscopic examination in due course; and then the atrophy was often attributed to many fanciful causes, among which the smoking of tobacco held a prominent place. It is not necessary to assume that tobacco is never injurious to the optic nerves, in order to be quite sure that the majority of the instances of atrophy once attributed to its influence were, in reality, due to a totally different cause. The changes associated with intracranial diseases will be found described in a special article. *See* Ophthalmoscope in Medicine.

8. '*Albuminuric Retinitis.*'—Very frequently in albuminuria, and occasionally in diabetes mellitus, the fundus of the eye becomes studded over with spots or patches of a glistening white colour, which are probably due to fatty degeneration of the connective tissue of the retina, and which are often associated with scattered hæmorrhages. The blood, in these instances, is usually effused into the fibre-layer, and, following the course of the fibres, becomes spread out into somewhat striated spots, with brush-like terminations. Every case in which either the white patches or the hæmorrhages, or both, are detected by the ophthalmoscope, whether with or without impairment of sight, calls for a careful examination of the urine, and renders it proper to follow mainly the indications of treatment which such an examination may afford.

9. *Hæmorrhages.*—Without the white patches, hæmorrhages may occur in the retina under various conditions. Sometimes they are distinctly arterial, in which case they are generally small in absolute amount, and may often be traced to some manifest point of rupture in the vessel from which they have occurred. These hæmorrhages seldom produce extreme impairment of vision, although they are usually discovered on account of some degree of impairment; and their chief importance is derived from the warning they may give of a state of brittleness of the arteries, and of a consequent liability to similar bleedings elsewhere, as in the brain. They call for all the precautions which such a state would suggest, as for the consumption of a diminished quantity of fluid, and for the avoidance of constipation and of all violent bodily efforts.

Hæmorrhages which are distinctly venous occur not infrequently in connexion with the disturbances of circulation which are incidental to the cessation of the menstrual function, or to the irregularities by which cessation is preceded. The blood may proceed from comparatively large veins, in which case it often forms a layer immediately beneath the *membrana limitans* of the retina, causing great temporary impairment of sight, or even total blindness; and yet, in many cases, being quickly absorbed without permanent injury. In other instances it may proceed from smaller and deep-lying veinlets, in which case the effusion will usually be situated in the fibre-layer, and will be moulded, so to speak, by the fibres, into what have been described as 'flame-shaped' hæmorrhages. These are generally multiple, and usually cause an impairment of function, which is decided although not total, and is often permanent. The flame-shaped hæmorrhages are said by Mr. Hutchinson to occur preferably in persons of gouty diathesis, and he holds the same doctrine with regard to a less common form, of which some remarkable examples have been observed by himself, and by Mr. Eales of Birmingham. In these cases, the subjects were young males, of constipated habit, and in many instances of gouty family history. The bleedings were large in amount, so as to penetrate into the vitreous body and to cause for a time total loss of sight, and were frequently recurrent. To what extent they were due to deficient plasticity of the blood, to abnormal friability of the vessels, to variations in vaso-motor tension, or to the withdrawal of external support from the vessels by diminished tension within the eyeball itself, is at present a matter of conjecture. It is obvious that the treatment of such cases, and of retinal hæmorrhages generally, must resolve itself into that of the constitutional conditions with which they are associated.

The only special indications, as regards the eye, will be the enforcement of functional rest, and the maintenance of an elevated position of the head during sleep. In cases connected with the cessation of the menstrual function, the absorption of the effused blood often appears to be promoted by the careful administration of iodide of potassium, which should usually be combined with ammonio-citrate of iron, or with some other suitable tonic, and care should always be taken to maintain a moderately relaxed condition of the bowels. Even apart from the injurious effects likely to be produced by straining, constipation appears to predispose to hæmorrhage.

10. *Embolism of the Central Artery.*—Sudden loss of vision is sometimes occasioned by the plugging of the central retinal artery by an embolus. This is especially to be suspected in cases of known valvular disease of the heart, and the condition is readily recognisable with the ophthalmoscope. The retinal veins are usually somewhat dilated, but their contained blood is broken up into irregular portions, in which an uncertain or wavering movement may sometimes be detected. The arteries are either obliterated, or so dwindled as to be scarcely visible. The connective tissue of the retina rapidly becomes cloudy and opaque, so that the general surface of the fundus is milky or opalescent; but in the region of the yellow spot, where there is little or no connective tissue, this opacity cannot be produced, and the red colour of the choroid shines through, producing the effect of a cherry-red spot on a white ground. After a few weeks the retina regains its transparency, but the optic nerve passes into a state of absolute atrophy.

R. Brudenell Carter.

OPHTHALMOSCOPE IN MEDICINE.—In a large number of diseases which come under the care of the physician—diseases of the nervous system, kidneys, blood, and other structures—intra-ocular changes occur, and may be observed with the ophthalmoscope. Hence this instrument is highly useful in practical medicine. By its aid we can observe, magnified about twenty diameters, the termination of an artery, of a vein, and of a nerve; a peculiar vascular structure (the choroid); and a peculiar nervous structure (the retina). Nowhere else are nerve and vessels exposed to direct observation. Many changes affecting these tissues throughout the body may be first and best detected here, and in some diseases these intra-ocular structures are affected in a special manner.

The chief changes in the fundus oculi which are of importance to the physician are the following: (*a*) In the *retinal vessels*: Variations in size, and in the condition of their walls; the existence of aneurysms; the tint of the blood; the occurrence of visible pulsation in arteries or veins, of hæmorrhages, or of vascular obstruction. (*b*) In the *optic nerve* or *papilla*: Congestion, neuritis or papillitis; atrophy, simple, consecutive (after neuritis), secondary (to disease of the trunk of the nerve), or choroiditic. (*c*) In the *retina*: Various inflammatory or degenerative changes or growths. (*d*) In the *choroid*: Inflammatory exudations, with their resulting disturbance of the choroidal pigment; atrophy; growths. For a description of these various changes the reader is referred to the special articles. In this place it is only possible to point out the changes which present themselves in the more important diseases which come under the physician's care.

I. Diseases affecting the Nervous System.—1. **Brain.**—Two forms of ocular changes are met with: (1) 'associated,' the consequence of the cause of the cerebral disease; (2) 'consecutive,' the direct result of the cerebral disease. *Anæmia* and *hyperæmia* of the brain are not, as a rule, revealed by any corresponding change in the retinal circulation, this being regulated in a special manner by the intra-ocular tension. Such changes, when affecting the whole head and considerable in degree, are, however, shared by the retinal vessels. Moreover, acute cerebral hyperæmia may, after a time, lead to congestion of the optic papilla. *Acute general cerebritis* is usually accompanied by meningitis, and to the latter the ophthalmoscopic changes are probably in part due. There is a very rare form of *chronic general cerebritis*, of which the symptoms are somewhat like those of tumour, but the only changes to be found after death are microscopic. In this condition well-marked neuritis (papillitis) may be present. Local cerebritis, which does not lead to the formation of pus, usually causes no ophthalmoscopic changes.

In *cerebral hæmorrhage* consecutive changes are extremely rare, and are almost confined to cases of meningeal hæmorrhage, from which slight neuritis may result. Of associated changes, aneurysms are rare, but have been noted; retinal hæmorrhages are not infrequent. They are most significant in blood-states, although most common in renal disease associated with albuminuric retinitis. In the latter they indicate vascular disease, but not necessarily that a cerebral lesion is hæmorrhagic, since they are often associated with softening of the brain.

In *softening from embolism*, retinal embolism may be, in rare cases, associated. In ulcerative endocarditis hæmorrhages may be seen in the retina—small extravasations with white centres. Consecutive changes are, as a rule, absent; occasionally slight optic neuritis is developed, apparently as a consequence of the irritant character of the softening produced by a plug from a malignant endocarditis.

In *softening from arterial thrombosis*,

when this is due to atheroma of the vessels, associated changes (hæmorrhages, or renal retinitis) may be found in the retina, but there are usually no consecutive changes. The latter are also absent in thrombosis from syphilitic disease of arteries; but associated changes—the various ophthalmoscopic manifestations of syphilis—are common, and are often of the highest diagnostic importance.

In *abscess of the brain*, optic neuritis occurs in a considerable number of cases, although not in all. It has no known relation to the position of the abscess, but is perhaps most frequent in the cases in which the abscess results from an injury.

Tumours of the brain.—Associated changes are very rare, and are confined to the cases in which a similar growth (glioma or tubercle) exists within the eye. Consecutive changes are more common than in any other cerebral affection. Optic neuritis occurs in about four-fifths of the cases. On what its occurrence or absence depends we do not know. Neither position, size, nor nature of growth seems to influence it in any considerable degree. It does not depend on increase of intracranial pressure. In some cases it is at least aided by the occurrence of meningitis. In many cases a slight descending inflammation may be traced from the optic tracts down the nerves to the eyes, and this, at the papilla, seems to be excited in a more intense degree, probably aided by the passage of irritant material down the sheath of the nerve to the lymph-spaces of the papilla. The sheath is commonly found distended after death. A tumour may exist for a long time without neuritis, or the neuritis may be present as soon as the symptoms of tumour manifest themselves. Often the neuritis and the tumour correspond in their course, each being acute or chronic. Both may even be almost stationary for years. An acute neuritis, occurring during the course of a tumour which appeared chronic, usually indicates an increase in the growth, and is of bad prognostic significance. The degree of neuritis varies; it is least in the tumours of most chronic course, and greatest in the rapid growths. It is often accompanied by hæmorrhages. Commonly bilateral, it is in rare cases unilateral, and is then usually in the eye opposite to the seat of the tumour. It may exist in considerable degree without impairing sight. Perception of colour may be affected before acuity of vision. If the tumour be arrested by treatment, as in syphilitic and tubercular growths, the neuritis will subside; it also often lessens when the intracranial pressure (which drives the fluid into the sheath of the nerve) is lessened by trephining the skull, and, still more completely, after removal of the tumour, when this can be effected. Too often, however, before this result is obtained, sight has been damaged beyond recovery. Secondary atrophy of the optic nerves sometimes results from tumours in the neighbourhood of the chiasma, although far less commonly than 'consecutive atrophy.'

Intracranial aneurysms are rarely accompanied by intra-ocular changes. Now and then, an aneurysm of the internal carotid has caused atrophy by pressure, and even optic neuritis, single or double.

Internal hydrocephalus is usually accompanied by no other ophthalmoscopic changes than slight fulness of the veins. Occasionally simple atrophy occurs, commonly from the pressure of the distended third ventricle on the optic commissure.

Meninges.—Growths in the meninges lead to optic neuritis, just as do tumours in the cerebral substance. The effect of meningitis varies according to its form and seat. Simple meningitis of the convexity is rarely attended by ocular changes. It is very different with basal tubercular meningitis. Occasionally, though rarely, tubercles of the choroid may be seen. In a considerable number of cases there is distinct neuritis; it is well-marked in at least half. Usually too late to be of diagnostic importance, it is now and then sufficiently early to decide the nature of the case. A similar change is common in both syphilitic and traumatic meningitis, but is rare in the epidemic cerebro-spinal form, except in cases of unusual duration.

Diseases of the cranial bones.—Caries of the sphenoid bone may cause descending neuritis; caries elsewhere usually only affects the eye by causing meningitis or abscess. Thickening of the cranial bones may be attended by well-marked, sometimes intense, neuritis, with hæmorrhages. This is apparently produced by the resulting constriction of the nerve and sheath at the optic foramen. Inflammatory mischief or growths in the orbit frequently cause neuritis or atrophy, the optic nerve-trunk being damaged directly. In these cases the affection is unilateral, at least for a long time, and is often accompanied by prominence of the eyeball, and tenderness when it is pushed back.

Injuries to the head may affect the eye in various ways: (1) The retina may suffer in consequence of the immediate concussion. (2) Optic neuritis may come on after a few days, commonly as the result of a traumatic meningitis. (3) Direct injury to the optic nerves may cause loss of sight and simple atrophy. (4) Optic neuritis may come on some weeks after the injury, and is usually due to inflammatory processes in the damaged brain.

2. **Spinal Cord.**—*Acute myelitis* and *spinal meningitis* are very rarely attended by eye-changes. In one or two cases coincident optic neuritis has been observed. The connexion between the two is obscure. *Sclerosis of the posterior columns* (locomotor ataxy) is accompanied by atrophy of the

optic nerves in a considerable number of cases, although not perhaps in more than 15 per cent. When it does occur it is frequently an early rather than a late symptom. It is always the simple form of atrophy, often grey, with unnarrowed vessels. Sight usually suffers gravely; the field of vision is much restricted; and perception of colours may be lost. The atrophy is not the result of any extension upwards of the disease in the posterior columns. It may occur when this has scarcely commenced, and even years before the earliest symptoms. It is apparently an associated degeneration. In *lateral sclerosis* changes in the fundus oculi are, as a rule, absent. In *disseminated sclerosis*, optic nerve-atrophy may occur, just as in posterior sclerosis, but less frequently. Damage to sight, without ophthalmoscopic changes, occasionally results from the sclerosis invading the optic commissure or nerves. In caries of the spine, changes in the optic disc are practically unknown. In very rare cases of injury to the spine, neuritis and subsequent atrophy have been observed, but these results are so uncommon that their precise significance is doubtful.

3. **Functional Diseases.**—In *exophthalmic goître* the only ophthalmoscopic change is increased size of the retinal arteries, which may pulsate visibly. In *chorea*, embolism of the central artery of the retina has been once or twice observed; and optic neuritis, slight in degree, is not rare. It is usually met with in hypermetropic eyes, but, nevertheless, subsides when the chorea is over. With *neuralgia* of the fifth, optic nerve-atrophy has been observed; the nature of the association is doubtful. In *idiopathic epilepsy* the appearance of the fundus is, as a rule, perfectly normal. Even during an attack it is probable that the only change is distension of the veins in the stage of cyanosis. But during the status epilepticus, when attacks recur with great severity for several days, a condition of slight neuritis may be produced, subsiding after the attacks are over. In cases of *convulsions* from organic brain-disease, it must be remembered, optic neuritis or its effects are often met with. The frequency with which morbid appearances are to be seen in the eye in *insanity* has been variously stated, and by some writers unquestionably exaggerated. They are most frequent in general paralysis of the insane. Optic nerve-atrophy is the usual change, and is sometimes an early event, just as in locomotor ataxy. In very rare cases slight neuritis has been seen. In mania, melancholia, and dementia it is probable that there are no related morbid appearances in the eye.

II. Diseases affecting the Urinary System.—1. **Bright's Disease.**—Sight may be impaired in this complaint by uræmic poisoning, or by retinal changes. The latter may occur, even in considerable degree, without any affection of vision. The arteries may occasionally be conspicuously narrow (contracted), and in rare cases may present sclerosis of the outer coat, or minute aneurysms. Aneurysmal dilatations of the capillaries may often be found *post mortem*, in association with other degenerations, and probably lead to the occurrence of a very common change in the retina—hæmorrhages. These are usually striated, situated in the nerve-fibre layer; sometimes they are irregular in shape, and situated in the deeper layers. They may detach the retina from the choroid, or burst through into the vitreous. Sometimes they exist alone; more commonly they are conjoined with other changes, to which the term 'albuminuric retinitis' is given. This latter change may occur in all forms of renal disease, but is by far the most common in the granular kidney. It is a late symptom, never appearing until the general system is suffering. The disease of the retina presents certain elements which are variously combined in different cases. (1) Diffuse slight opacity and swelling of the retina, due to the infiltration of its substance by an albuminous coagulable liquid (œdema). (2) White spots and patches of various size and distribution: some large and soft-edged; others minute, and of pearly whiteness. They are due to fatty degeneration of the retinal elements, or to granular degeneration of albuminous exudations. The small white spots often radiate around the macula lutea. (3) Hæmorrhages. (4) Inflammation of the optic papilla—'neuritis.' (5) The subsidence of the inflammatory changes may be attended with the signs of atrophy of the optic nerve and retina. According to the predominant character, four types of retinal affection may be distinguished: a degenerative, hæmorrhagic, inflammatory, and neuritic form. In the first the white spots predominate, and there are usually extravasations, but there is little diffuse opacity. In the second the hæmorrhages are so abundant as to be the chief feature. In the third there is much diffuse opacity and swelling of the retina. In the fourth the optic neuritis is in excess of the other changes, and the appearance may easily be ascribed to cerebral disease—the more so that it is often conjoined with headache, and other evidence of cerebral disorder. The conspicuous combination of white spots and hæmorrhages usually enables the retinal affection of albuminuria to be recognised without difficulty. It may be confounded with the degeneration left by a previous wide neuro-retinitis, but in such cases the signs of atrophy will be conspicuous. The course of the affection in Bright's disease is often progressive, but arrest and even recovery may be obtained by the treatment of the renal disease. When extensive, sight is usually impaired, but is rarely completely lost.

2. **Diabetes Mellitus.** — In diabetes mellitus, in rare cases, retinal changes have been observed exactly similar to those of the degenerative form of the albuminuric affection, and this when there was no albumen in the urine. Miliary aneurysms have been found *post mortem*. A distinction from the renal form is the frequency with which there are opacities in the vitreous, due probably to slight extravasations of blood.

III. Diseases of the Heart.—The peculiar conditions of the intra-ocular circulation prevent any dynamical changes in the circulation. Venous distension, if considerable, may be visible in the eye, especially in cyanosis. When arterial pulsation is strong, it may be seen in the retinal arteries, as in exophthalmic goître and in aortic regurgitation. In these cases also the arterial pulsation may (probably in the sclerotic ring) be communicated to the vein, and this also may pulsate. Embolism of the central artery of the retina may occur, and, like embolism elsewhere, is most common in mitral constriction. In ulcerative endocarditis, accompanied with multiple embolism, retinal hæmorrhages occur, for the most part round, with a pale or white centre. They are almost pathognomonic.

IV. Diseases of the Blood. — Acute *anæmia* from hæmorrhage may be followed by loss of sight, slight or considerable, transient or permanent. The accident most commonly follows hæmatemesis, uterine hæmorrhage, or venesection. In some cases no ophthalmoscopic changes have been found; in others there has been neuro-retinitis. The mechanism of the affection is obscure. Simple chronic anæmia is accompanied by marked pallor of the veins, sometimes of the choroid and disc, but the latter is always within the physiological variations in tint. Occasionally in chlorosis optic neuritis is met with, developing quickly to a high degree of intensity, such as is met with in cerebral tumour. It disappears rapidly under iron, but too often ignorance of the cause has led to the loss of so much time, while iodide of potassium, &c., have been given, that sight is hopelessly damaged. In *pernicious anæmia* the choroid is notably pale, the arteries small, the veins very broad (atonic) and pale. Hæmorrhages are frequent, especially around the optic disc, and they are often associated with white patches. Some extravasations are rounded, with a white or pale centre. Occasionally there is marked neuritis. In *leucocythæmia* the pallor and the width of the veins are very striking. Extravasations are almost invariable at some period. White spots are frequent; some degenerative, others due to aggregations of leucocytes; some are surrounded by a halo of extravasation. There may also be considerable general swelling of the retina, throwing the distended veins into conspicuous antero-posterior curves. In *purpura* and *scurvy* retinal hæmorrhages also occur. In the intense forms of purpura, indeed, they are probably constant, and may be large. They have sometimes been seen in the choroid.

In rare cases of *menstrual* disorders, and still rarer instances of *intestinal* disturbance (chronic diarrhœa), optic neuritis has been observed. Suppression of the menses has been followed by retinal hæmorrhages. The connexion between the several events is obscure.

V. Chronic General Diseases.—In chronic general diseases ophthalmoscopic changes are met with occasionally. In *tuberculosis*, tubercles may form in the choroid, and be recognisable as small, round, yellowish-white spots, free from pigment. They have more frequently been found in this situation after death than during life, perhaps because not looked for with sufficient perseverance, since they may form rapidly. They are sometimes of great diagnostic importance, especially in cases of general tuberculosis causing obscure and ill-defined symptoms. In *syphilis* ocular changes are, as is well-known, common, but they come chiefly under the care of the surgeon. Traces of past iritis, or of choroiditis—areas of choroidal atrophy with irregular accumulation of pigment—frequently afford the physician important evidence of the previous existence of syphilis, acquired or inherited. In the latter the choroidal changes are of especial importance, and may be confined to small round white spots with pigment in the centre, or there may be evidence of more extensive choroiditis or merely of choroiditic atrophy, a yellowish disc, with the edge a little blurred, and very small retinal vessels. *Gout* has been supposed to cause retinal hæmorrhage (Hutchinson), and to it is probably due the widespread 'hæmorrhagic retinitis' that is the consequence of thrombosis in the central vein of the retina. Intra-ocular neuritis is seldom due to this cause, except in slight degree, as the result of a more intense inflammation behind the globe. This may occur in the subjects of acquired gout, or in young persons the subjects of the inherited disease, and may be on one side or on both, simultaneously or in succession.

In *lead-poisoning*, besides the amblyopia which may come on without ophthalmoscopic changes, atrophy of the disc is occasionally met with, preceded, in some cases, by a stage of congestion—a red disc, with softened edges, without swelling. A considerable degree of neuritis, double, with swelling and hæmorrhages, occurs occasionally, especially in connexion with cerebral symptoms, but without any coarse lesion of the brain. In *chronic alcoholism*, optic-nerve atrophy has been described, and also a condition of congestion. The amblyopia which accompanies the

atrophy is said by Förster to be characterised by loss of central vision for colour. The same fact is well established with regard to *tobacco* amaurosis, in which similar congestion and atrophy may occur.

VI. Acute General Diseases.—In acute general diseases, changes in the fundus are for the most part rare. After *typhus*, *typhoid*, and *scarlet fevers*, optic neuritis has been occasionally observed, apart from any renal or cerebral complication. The renal sequelæ of scarlet fever may of course lead to the special retinal changes. *Malarial fevers*, *ague*, &c., are frequently attended with retinal hæmorrhages (Poncet, S. Mackenzie). Sometimes the extravasations have paler centres. Optic neuritis and atrophy have also been observed. *Erysipelas of the face* has been accompanied by loss of sight, and followed by atrophy, probably by the extension of the inflammation to the orbit, and to the trunk of the optic nerve. *Pyæmia* and *septicæmia* have long been known to be occasionally accompanied by metastatic panophthalmitis, and recent observation has shown that slighter alterations in the fundus oculi frequently accompany the severer forms of these affections. Of these the most important are retinal hæmorrhages, round or irregular, sometimes large, and often with pale centres, as in ulcerative endocarditis. Although it is probable that they are in some cases due to septic embolism, they may occur without endocarditis, and may be due, in some cases, to chemical changes in the blood, produced by the organised virus of the septicæmia. They are almost invariable in puerperal septicæmia (Litten). They are of very grave significance, but not necessarily a fatal omen. In other cases a peculiar form of retinitis has been observed, with white spots about the papilla and macula lutea (Roth).

Most of the appearances mentioned above will be found figured in the writer's *Manual and Atlas of Medical Ophthalmoscopy*.

W. R. Gowers.

OPISTHOTONOS (ὄπισθεν, backwards; and τόνος, a stretching).—A tetanic spasm, in which the body is arched backwards, so that it rests on the head and heels. *See* Tetanus.

OPIUM, Poisoning by.—In consequence of the extent to which opium and its preparations, including morphine, are used for the relief of pain, and the readiness with which the drugs are procurable, poisoning by these agents is of frequent occurrence; and there is no doubt that great numbers of infants perish every year in this country through the improper use of quack remedies containing opium.

So far as toxicology is concerned, the effects of opium may be referred exclusively to morphine; since the effects of the other active constituents of the drug are overshadowed by those of its chief alkaloid. *See also* Morphinism.

Anatomical Characters.—The *post-mortem* appearances after opium-poisoning may be almost *nil*. As a rule the brain is congested, the *puncta cruenta* being especially marked; and the lungs and right side of the heart may exhibit an engorgement, as if from a modified asphyxia; but this condition is by no means invariable.

Symptoms.—The first effect of the administration of a toxic dose of opium—a state of *bienfaisance* or exaltation—commonly observed also after the administration of a medicinal dose, may be either very short or entirely wanting; and this is usually the case when morphine is injected hypodermically. A second stage, in which the symptoms closely resemble those of congestion of the brain, soon sets in. The face is either suffused or cyanosed; the pupils strongly contracted; the skin dry and warm; the breathing slow, deep, and becoming stertorous. The patient is apparently unconscious, but may be aroused by shaking, or shouting in the ear; and when he is aroused, the respirations become more rapid, and the skin may regain its normal colour. The symptoms of this second stage may gradually ameliorate under appropriate treatment; or a third stage—that of prostration—supervenes. The coma is now profound, and it may be impossible to arouse the patient. The pupils are contracted to the size of pin-points; or towards the termination of life may be widely dilated. Respiration is now very slow, shallow, with gradually increasing intervals, during which there are no signs of breathing, and the patient lies in a death-like calm. The face is at once pallid and cyanosed; the skin is bathed in perspiration, at first warm, and then cold and clammy. The pulse increases in rapidity, with progressively increasing feebleness. The patient may even now recover, signs of life returning very gradually; or death may occur from failure of respiration, the other functions of life becoming also gradually extinguished.

Unusual symptoms in opium-poisoning are trismus and convulsions. In children toxic doses may produce very rapid effects, the second stage of the intoxication being wanting, and severe collapse and complete unconsciousness rapidly supervening.

Diagnosis.—The certain diagnosis of opium-poisoning is often a matter of great difficulty, as the symptoms may differ in no material respect from those exhibited in congestion of the brain, however produced, apoplexy, and uræmia. The case may also be confounded with profound alcoholic intoxication. It may also be difficult or impossible to diagnose from poisoning by chloral hydrate —a matter of less importance, since the treat-

ment of the two cases would be similar. The differential diagnosis of opium-poisoning rests upon the equally and minutely contracted state of the pupils, a condition which is all but universal in the second stage of opium-poisoning; our ability to arouse the patient temporarily, the rousing being followed by more or less complete disappearance of the cyanosis of the countenance, and by increased rapidity of respiration; and the profuse warm or clammy cold perspiration. An examination of the urine, which may have to be drawn off by the catheter, for albumen should always be made; but it must be borne in mind that uræmia and opium-poisoning may be co-existent.

Prognosis.—This is at all times doubtful. There is great liability to relapse, even when the patient appears to be doing well.

Treatment.—First, evacuate the stomach by means of the stomach-pump, or, failing this, by the use of emetics. These, however, act with difficulty in cases of opium-poisoning; and there is a special danger in the use of depressing emetics, as, for example, tartar emetic, on account of the possible retention by the stomach of a fatal dose of the emetic. Warm mustard and water, and carbonate of ammonium, are the best emetics to administer. Secondly, the patient must be prevented lapsing into a state of somnolence, by walking him about; alternate warm and cold applications to the chest; flicking the feet with a damp towel; shouting into the ear; and the application of the faradic current. These means will have the additional advantage of maintaining the flagging respiration, and restoring normal breathing. In the last resort artificial respiration must be freely employed. The absorption of the alkaloids of opium may be delayed by the free administration of solutions containing tannin, so as to render the alkaloids insoluble; and among the best media containing tannin are strong infusions of tea and coffee. The caffeine which these infusions contain, itself also exerts a powerful remedial influence in this form of intoxication. Atropine, as a respiratory stimulant, appears also to be most serviceable as a direct antidote to morphine. It is best given by subcutaneous injection, in doses of $\frac{1}{70}$ to $\frac{1}{20}$ grain. Alcoholic stimulants should be freely given.

Thomas Stevenson.

OPIUM-EATING.—*See* Morphinism.

OPPRESSION.—A term applied to a sense of weight or pressure in any part of the body, but more frequently used in connexion with the chest and epigastrium. The expression is sometimes also employed in reference to a general feeling of the system being overloaded or overweighted, which is felt at the commencement of certain acute diseases, as well as in other conditions.

OPTIC NERVE and TRACT, Diseases of.—The optic nerve may be damaged by various intra-ocular processes; but these, and also its primary atrophy, have been already described (*see* Eye, and its Appendages, Diseases of; Ophthalmoscope; and Ophthalmoscope in Medicine). In this article only those affections which are situated behind and independent of the eye will be described.

Passing from the orbit into the intracranial cavity by the optic foramina, into which they closely fit, the optic nerves are connected at the chiasma, where an approximate semi-decussation takes place. From the chiasma each optic tract, containing fibres from the same-named halves of both retinæ, passes backwards, between the crus cerebri and the inner edge of the temporo-sphenoidal lobe, to the posterior portion of the optic thalamus, where it becomes connected with this and the external geniculate body. Fibres pass also to the corpora quadrigemina, especially the anterior; and from the thalamus to the convolutions of the occipital lobe.

Ætiology.—In the orbit the nerve may be damaged by inflammation, which is sometimes apparently due to gout, and sometimes invades the nerve from the orbit (as in orbital cellulitis from facial erysipelas), or is produced by exposure to cold. Inflammation outside the nerve rarely invades its substance on account of the thickness of the sheath which invests it, but the fibres are damaged by the pressure of the inflammatory products. It may also be compressed by an aneurysm of the ophthalmic artery or by orbital tumours; or may be itself the seat of morbid growths or of hæmorrhage. At the optic foramen the nerve may be compressed by new-growths or by a narrowing of the foramen, such as occurs in thickening of the cranial bones, an occasional consequence of syphilis, acquired and congenital. Within the skull, the nerve in front of the chiasma may be damaged by the extension of inflammation from the meninges. The optic commissure is occasionally compressed by or involved in growths, and may be compressed by great distension of the third ventricle. Interstitial inflammation probably sometimes occurs. The nerves in front of the chiasma, and the chiasma itself, are liable to be damaged by the pressure of aneurysms of adjacent arteries. The optic tracts may be involved in hæmorrhage into, or softening of, the crura cerebri; but the most frequent cause of their damage is a tumour arising at the base of the brain, or in the adjacent part of the temporo-sphenoidal lobe. The central continuation of the optic nerves, constituting the visual path—the optic thalamus, the white substance from it to the occipital lobe, and occipital cortex, may be damaged by tumour, softening, or hæmorrhage, with impairment of sight as the result. The corpora

quadrigemina are rarely affected so as to cause visual symptoms, except by growths, which produce this effect by pressure on the adjacent visual path to the cortex.

Symptoms.—Damage to the optic nerve, between the optic commissure and the eye, causes an affection of sight in that eye only. There may be either a concentric or sectorial defect in the field, or complete blindness; the reflex action of the pupil is impaired. When the nerve is slowly compressed, the loss of sight is followed by slow atrophy of the intra-ocular extremity. When it is invaded by inflammation, this usually descends to the eye, and is visible as intra-ocular neuritis, often slight; it may ascend to the commissure, and the sight of the other eye then suffers. Inflammation at the back of the orbit usually also involves the motor nerves, and so may cause paralysis of all the ocular muscles. These recover, however, much more readily than does the optic nerve. When the nerve is compressed by narrowing of the optic foramen, the loss of sight is usually accompanied by intra-ocular atrophy or slight neuritis. This is also present in most cases in which inflammation extends from the meninges to the intracranial part of the optic nerves, or the optic chiasma, but seldom in extension to the optic tract. Damage to the chiasma usually affects the sight of both eyes. In most cases the decussating fibres suffer chiefly or alone, and consequently there is loss of function of the inner half of each retina, and loss of the outer half of each field of vision—*temporal hemianopia*. Damage to the outer part of the commissure on each side affects the fibres which do not decussate, and so causes loss of function of the outer half of each retina, and so loss of the inner half of each field—*nasal hemianopia*. This is very rare, but has been seen from calcification of the carotid artery on each side (Knapp). Partial nasal hemianopia is also sometimes met with in tabes. In irregular damage to the chiasma the loss of vision may be irregularly distributed in the two eyes.

The optic tract receives fibres from the half of each retina on the same side, and its damage thus causes loss of sight in the opposite half of each field of vision—*lateral* or *homonymous hemianopia*. The loss is often more extensive in the eye on the side opposite to the lesion than in that on the same side. Since the motor tract, in the adjacent crus cerebri and hemisphere, has decussated at the medulla, if it is also involved in the lesion, there is hemiplegia on the same side as the loss in the field of vision. The patient is unable to see to the side on which he cannot move the limbs. Thus the writer has recorded a case in which a patient had, first, right hemianopia, and afterwards right hemiplegia. Both were due to a small tumour of the inner part of the temporo-sphenoidal lobe, which had first invaded the optic tract and then the crus.

Lateral hemianopia results, occasionally, from disease of the posterior extremity of the optic thalamus, and frequently from a lesion involving the fibres that pass thence, adjacent to the posterior extremity of the internal capsule, and through the white substance of the occipital lobe, to the cortex at the extremity of the hemisphere, and chiefly to the cuneus, disease of which always entails this symptom. Partial disease of the cuneus causes a partial loss of the half field; the upper quadrant is lost if the upper half of the cuneus is diseased, the lower quadrant of the field if it is the lower half of the cuneus. It is uncertain whether damage to the cortex on the outer surface of the occipital lobe causes hemianopia, or whether, with this lesion, the symptom has been due to the disease penetrating the white substance to the fibres from the cuneus. These fibres, the 'optic radiation of Gratiolet,' may be reached by extensive disease of the middle part of the cortex, and then hemianopia may be associated with hemiplegia, and even with aphasia. When the cause of hemianopia is disease of the chiasma or tract, the pupil does not contract when light is thrown on the blind half of the retina (Wilbrand, Wernicke, &c.), because the fibres for the reflex centre are involved. When the disease is in the thalamus or occipital lobe there is no loss of action; this affords a means of distinction, but much care is needed to get clear results.

Double hemianopia involves complete loss of sight, and is the probable cause of such loss, when of sudden onset. Half loss of the colour-fields, with no loss for white light, has been observed, and perhaps depends on a hemiopic colour-centre on the outer aspect of the occipital lobe.

In hysteria, with loss of the other special senses on one side, there is a peculiar affection of vision, which is sometimes met with as a result of organic disease—'crossed amblyopia.' There is dimness of sight of the eye opposite to an organic lesion, and great contraction of the field, with loss of colour-vision; on the side of the lesion there is a much slighter but similar change. In the cases in which the lesion has been ascertained, it has always involved the angular gyrus in the postero-inferior angle of the parietal lobe, in front of a line drawn across the brain from the parieto-occipital fissure. It would seem that here there is a centre related to both half vision centres, in which they are recombined, but to which the opposite field is chiefly related. A partial lesion in this centre can be compensated by the other hemisphere, but the effect of a partial lesion in the half-vision centre is permanent, as much so as one in the optic path leading to it.

Any one of the diseases to which the brain is subject has the same effect if in a corresponding situation; but, as a rule, softening from arterial obstruction, due to syphilitic disease or atheroma, or a new-growth, is a more frequent cause of damage to the optic path in tract or hemisphere than is cerebral hæmorrhage.

Diagnosis.—The chief points which are our guides in determining the position of post-ocular disease, causing loss of sight, have been already stated. If the affection of sight is confined to one eye, it is probably —and if associated with unilateral optic neuritis it is almost certainly—due to disease of the nerve in front of the chiasma. In this case the reaction of the pupil to light is impaired. On the other hand, if the unilateral affection of sight is associated with hemiplegia, and especially with hemianæsthesia, on the same side, it is probable that the disease is in the hemisphere, and the failure of sight is produced in some manner at present unknown. In this case the pupil acts well to light. Lateral hemianopia indicates disease of the tract, the posterior part of the thalamus, or the white substance between the thalamus and the occipital convolutions, or of these convolutions themselves. In which of these positions it is, must be determined by the indications of the localisation of disease of the brain (*see* Convolutions of the Brain and Cortex Cerebri, Lesions of). Nasal hemianopia or temporal hemianopia indicates disease of the optic chiasma.

Prognosis.—This must be influenced by the position of the lesion, and especially by its nature. When there is simple pressure on the optic nerve, sufficient to abolish sight, the prognosis is very unfavourable. Damage due to the extension of inflammation often lessens considerably. In disease of the optic commissure or optic tracts the prognosis is also grave, because the morbid processes, from which these parts suffer, rarely recede. Whether it is likely to become stationary must be inferred from its probable nature. On the other hand, in disease of the hemisphere, considerable improvement often takes place, just as it does in other symptoms; but when the hemianopia has become stationary it persists, with little change, to the end of life. Often, however, this symptom is thought to have disappeared when it still persists in a diminished degree.

Treatment.—The treatment is essentially that of the disease to which the symptom is due, and need not be further discussed in this place.

W. R. Gowers.

OPTIC THALAMUS, Lesions of. *See* Thalamus Opticus, Lesions of.

ORANGE FREE STATE. — *See* Africa, South.

ORBIT, Diseases of. — Synon.: Fr. *Maladies de l'Orbite*; Ger. *Krankheiten der Augenhöhle*.—The diseases of the orbit are not numerous, and are almost exclusively surgical in their character. The bony walls of the cavity are liable to be fractured by direct injury, which generally implicates other portions of the skull; the contained tissues are liable to phlegmonous or suppurative inflammation; and the cavity may be the seat of tumours of various kinds, arising either from the walls or from some portion of the contents.

1. **Hæmorrhage.** — Hæmorrhages into the orbit, excepting as results of injury or from the rupture of aneurysmal tumours, are extremely rare; and the few cases which have been recorded have nearly all occurred in persons of generally hæmorrhagic tendency, as one local manifestation among others of a constitutional malady.

2. **Emphysema.** — Emphysema of the orbit is not unknown, and the writer has seen a young man who, in blowing his nose violently, must have ruptured some of the ethmoidal cells, for he distended his left orbit with air, and, in his own words, blew his eye nearly out of his head. The distension soon subsided, and no permanent injury was done.

3. **Inflammation.**—Inflammation of the tissues within the orbit is not a common affection, but it is liable to occur as a complication of fevers and other debilitating diseases, and especially as a complication of erysipelas of the head and face. It is marked by brawny swelling of the eyelids, with some protrusion of the eyeball and some limitation of its movements, the symptoms appearing too suddenly and increasing too quickly to be attributable to the growth of a tumour. The injection of the conjunctiva is generally less marked than that of the lids, and sight is scarcely or not at all impaired so long as the swelling is only moderate in amount. When the injected conjunctiva of the eyeball becomes œdematous, and more especially when the œdema is limited to one sector of the globe, or is much more pronounced over one sector than elsewhere, it is, in the opinion of the writer, an almost pathognomonic sign of suppuration; and the localisation of the œdema will serve as a guide to the position in which pus may be looked for. Other symptoms of suppuration, such as rigors, must of course be taken into account.

Treatment.—As soon as pus is believed to exist, it should be evacuated, since its retention among the orbital tissues may be productive of serious injury, not only to the eye, but also to the ocular muscles and to the nerves which traverse the orbital cavity. The evacuation is usually best effected by introducing a narrow straight knife through the skin, near the margin of the orbit in the

selected position, and by thrusting it carefully onward as far as may be prudent, giving the blade an occasional turn upon its axis, to allow of the escape of pus as soon as it is reached. The direction of the point should be governed by complete knowledge of the anatomy of the parts; and it is better to withdraw the blade too soon than to incur any risk of wounding important structures. When it is withdrawn, if no pus follow, the puncture may be carefully deepened or extended laterally by a probe; but it is not necessary to be very strenuous in such endeavours, because if the wound through the skin and fascia be kept from healing by the introduction of a strip of lint, or of a bit of drainage-tube, the pus will soon find its way into the channel of escape thus provided for it. The cavity of the abscess should be syringed out from time to time, according to the amount of discharge, with some suitable astringent or antiseptic lotion; and care must be taken that a free opening is maintained as long as pus continues to be secreted.

4. **Caries.**—In strumous children, caries of some part of the margin of the orbit is not uncommon; and, after the diseased bone has come away, we frequently see much deformity of the lids produced by adhesions between the skin and the deeper tissues, or by the contraction of cicatrices. Many of such cases require plastic operations; but each one, before any operation is undertaken, must be carefully studied in order to discover the most promising method of procedure. In a lad with inherited syphilis, the writer has seen very extensive necrosis of the orbital margin, subsequent to the partial removal, and partial absorption, of a large gummatous tumour in the cavity.

5. **Tumours.**—Tumours of the orbit may be cysts (hydatid, dermoid, or sebaceous); lipomata; gummata; sarcomata, originating in connective tissue, and presenting the characters of myxoma, or of the sarcomatous growths distinguished respectively by round and by spindle-shaped cells; or they may be gliomata, springing from the connective tissue of the optic nerve. In other instances they may commence as an apparent hypertrophy of the lachrymal gland; or they may be cartilaginous, or osseous. All alike produce protrusion of the eyeball, and limitation of its movements, together with an amount of disturbance of vision, which depends upon the degree of pressure or of stretching to which the optic nerve is subjected, or upon the degree in which the intra-ocular circulation is impeded. Many of the forms are liable to recurrence, and may thus ultimately destroy life.

Treatment. — All tumours of the orbit alike require removal, if possible, without sacrifice of the eyeball.

R. Brudenell Carter.

ORCHITIS (ὄρχις, a testicle).—Inflammation of the testis. *See* Testes, Diseases of.

OREZZA, in Corsica.—Iron waters. *See* Mineral Waters.

ORGANIC DISEASE. — This expression indicates a discease in which there is a structural change in the part affected, as distinguished from a merely functional disorder, in which there is no evidence of such change. *See* Disease.

ORGANS, Displacement or Malposition of.—The special malpositions of the chief individual organs are considered in the articles which are devoted respectively to these organs, and it is only intended here to discuss the subject from a general point of view. A distinction is sometimes made between *malposition* and *displacement*, the former including all changes of position, from whatever cause; the latter implying that the organ has by some force been displaced from its normal situation after it has occupied it; and the term *dislocation* has also been used in the same sense. For all practical purposes they may be considered together.

Ætiology and Pathology.—The circumstances under which an organ comes to occupy an abnormal position may be thus summarised: 1. The condition may be *congenital*, the organ never having been in its proper place. In this way all or part of the organs occupying the chest and abdomen may be transposed to the wrong side of the body (*see* Malformations). In this connexion may also be mentioned the fact that an organ, which some time or other after birth changes its place in the ordinary course of development, may fail to do so, and thus remain in a wrong situation. This may be illustrated by the testis, which occasionally is retained in the cavity of the abdomen or the inguinal canal, instead of descending into the scrotum. 2. A violent strain or effort is liable to cause displacement of an organ, especially if repeated several times. This has been made to account for some cases of movable kidney; and hernia may certainly arise in this way. 3. Malposition may depend upon imperfection in the attachments or supports of an organ. This may be congenital, the attachments being unusually long or loose; or they may become repeatedly stretched from different causes, and thus rendered inefficient. The kidney, again, affords an illustration of this cause of displacement; and also the intestines, certain portions of which may come to occupy an abnormal position owing to the unusual length of their peritoneal attachment. 4. Another cause of displacement of organs is to be referred to abnormal conditions con-

nected with orifices or canals, which either remain patent or too large, when they ought to have closed or contracted; or which have been artificially formed, as the result of injury or other causes. Thus, a large inguinal canal and orifice, or non-closure of the peritoneal prolongation, may account for inguinal hernia; or a new opening may be produced in some part of the muscular or tendinous structures of the abdominal wall, leading to some form of ventral hernia; or an opening may remain, or be formed after birth, in the diaphragm, and hence an organ be displaced from the abdomen into the thorax, or *vice versâ*. 5. Pressure is an important cause of displacement of organs. This may come from without, as from wearing tight stays or a belt; but is of most importance in connexion with morbid conditions within the body. Accumulations of a liquid, gaseous, or solid nature, whether the last-mentioned be due to enlarged organs or separate tumours, are frequent causes of malposition of organs, either temporary or permanent. This is well illustrated by the effects of pneumothorax, pleuritic effusion, or an intra-thoracic growth upon the lungs and heart, or even upon certain abdominal organs; and the same thing occurs from similar conditions within the abdominal cavity. 6. Traction is another force which causes displacement of organs. The action of the lung free to expand in cases of unilateral pleuritic effusion has been supposed to aid in the lateral displacement of the heart, by exercising a kind of elastic traction upon it; but this cause is best exemplified by the effects of the contraction of diseased organs upon neighbouring organs, to which they have become adherent. For instance, the heart is frequently altered in its position as the result of a contracted cavity at the apex of the lung, in cases of phthisis. The contraction of adhesions themselves may assist in originating more or less malposition, and they frequently cause the altered situation of an organ to be permanent, by fixing it in its new position. 7. Disease in an organ itself may originate its own displacement. It commonly happens that such disease enlarges or contracts an organ, and thus causes it to pass beyond or to be drawn within its normal limits; but, further, an organ may become so heavy as the result of disease, that by its own weight it displaces itself in the direction of gravitation. 8. In the case of certain muscular hollow organs, such as the intestines, excessive or irregular action of the muscular coat may lead to malposition. In this way hernia may be originated, or internal strangulation of the intestine, or intussusception of one part of the bowel into another. In this connexion the influence of straining at stool in causing protrusion of the lower part of the rectum may be alluded to. 9. The displacements of the uterus constitute a special group, the causes of which are much discussed. Probably prolonged standing is one element in the causation of some of these displacements in certain cases.

Varieties.—The principal varieties of malposition of organs have been casually indicated in the preceding remarks, but it may be useful to arrange them more systematically. 1. An organ may occupy a wrong cavity altogether; for example, the stomach or liver may lie in the chest, or partly in both chest and abdomen. 2. There may be a transposition of one or more of the viscera to the wrong side of the body. 3. An organ remains in its proper cavity, but is more or less removed from its normal position. This may merely be a temporary change, the organ returning to its place when the cause of the displacement is got rid of; or it is a permanent condition, the organ being fixed in its new site. 4. Instead of being normally fixed, an organ may be more or less freely movable, so that its situation can be altered by change of posture, manipulation, or in other ways. 5. A portion of an organ may protrude out of its cavity, so as to lie under the skin or amongst the muscles, as in external hernia; or it may even come altogether out of the body, as happens when organs are protruded in consequence of injury, with an external wound. A portion of the brain may thus protrude through an opening in the skull after injury, constituting the so-called *hernia cerebri*. The displacements named *procidentia* and *prolapsus* may also be mentioned here. 6. In the case of the intestine, one part may alter in its relations to other parts, as happens in the case of invagination. Coils of the bowel also occasionally find their way into curious positions, owing to the presence of bands of adhesion, openings in the mesentery, and other abnormal conditions which predispose to their displacement (*see* Intestinal Obstruction). 7. The uterus presents special malpositions, both as a whole, and in relation to its different parts, which need not be discussed here. *See* Womb, Diseases of.

Effects and Symptoms.—There may be no manifest results whatever of the displacement of an organ, or at least such as can be regarded of much or any consequence. On the other hand, this condition may, if brought about suddenly or acutely, be attended with immediate symptoms of a grave nature. For instance, in the case of the intestine, obstruction to the transit of its contents is often produced, and other serious results ensue, familiar enough in cases of hernia; while rapid displacement of the heart may lead to grave embarrassment of its action, and prevent the passage of blood into the arteries, by altering the relation of their orifices to the cardiac cavities. In chronic cases also displacement of an organ frequently gives rise to phenomena of greater

or less importance. Thus, its own functions are not uncommonly disturbed, and may be seriously interfered with, as happened in a case observed by the writer, where the stomach passed through the diaphragm into the thorax. The displaced organ may also produce physical effects, such as irritation or pressure, and thus give rise to pain or other subjective sensations, or to symptoms obviously connected with other structures and organs. Physical examination often reveals malposition of an organ, and this is one of the conditions which should always be borne in mind when examining the more important viscera. In some instances it assumes the characters of a tumour, as in the case of movable kidney; and this may prey so much upon the mind of the patient as to lead to considerable general disturbance, although the condition may really not be of much moment. It must be remembered that an organ may be diseased at the same time that it is displaced, and then the symptoms are likely to be more marked.

Treatment.—When an organ is suddenly or acutely displaced, and the displacement is attended with serious symptoms, the first aim in treatment should be to endeavour to restore it to its normal position as soon as possible. This may be illustrated by the treatment of hernia and other forms of intestinal displacement, or of protruded organs, as the result of injury; and by the removal of pleuritic effusion, by operative methods, when it gravely impedes the cardiac action in consequence of displacing the heart. In chronic cases the same principle should be kept in view in the first instance. For this purpose any causes of displacement should be removed, and it may be necessary to employ mechanical means, or even to adopt operative procedures, to prevent a recurrence of the malposition. This may also be exemplified by the treatment of hernia, and of displacement of the uterus. In many cases, however, the restoration of an organ to its normal position is impracticable. Under these circumstances no particular treatment may be required; or perhaps any ill-effects resulting from the malposition may be obviated by the application of a bandage or other means of mechanical support, as in the case of movable kidney. Medicinal agents may be of service in combating symptoms, and in improving the general condition, if required. When a malposition is of no consequence, the patient's mind should be made quite easy on the point, especially if any notion is entertained of the existence of a tumour.

Frederick T. Roberts.

ORTHOPNŒA (ὀρθός, erect; and πνέω, I breathe).—A form of difficult breathing, in which the patient is unable to lie down, and is compelled to assume the sitting or erect posture. *See* Respiration, Disorders of.

ORTHOTONOS (ὀρθός, straight; and τόνος, a stretching).—A form of tetanic spasm, in which the body is rigidly extended. *See* Tetanus.

OSMIDROSIS (ὀσμή, odour; and ἱδρώς, sweat).—A condition of the perspiration in which it yields an unusually strong or fœtid odour. *See* Sudoriparous Glands, Disorders of.

OSSEOUS DEGENERATION.—A kind of degeneration, in which the affected textures assume the characters of bone. *See* Degeneration.

OSSEOUS SYSTEM, Diseases of. *See* Bone, Diseases of.

OSTEITIS (ὀστέον, a bone).—A synonym for inflammation of bone, which may be of various kinds. *See* Bone, Diseases of.

OSTEOCOPIC PAINS (ὀστέον, a bone; and κόπος, fatigue).—Aching pains in bones. *See* Syphilis.

OSTEOID CANCER.—This term has been vaguely employed, as implying a cancer including bony structure, or with reference to malignant disease involving a bone. *See* Bone, Diseases of; Cancer; and Tumours.

OSTEO-MALACIA (ὀστέον, a bone; and μαλακός, soft).—A synonym for mollities ossium. *See* Mollities Ossium.

OSTEO-MYELITIS (ὀστέον, a bone; and μυελός, the marrow).—A name for inflammation of the medulla of bone. *See* Bone, Diseases of.

OSTEO-SARCOMA (ὀστέον, a bone; and σάρξ, flesh).—A sarcomatous growth in connexion with bone. Also a sarcoma with tendency to ossification. *See* Bone, Diseases of; and Tumours.

OTALGIA (οὖς, ὠτός, the ear; and ἄλγος, pain).—Pain in the ear: earache. *See* Ear, Diseases of.

OTITIS (οὖς, the ear).—Inflammation of the ear. *See* Ear, Diseases of.

OTORRHŒA (οὖς, the ear; and ῥέω, I flow).—Discharge from the ear, usually purulent. *See* Ear, Diseases of.

OVARIES, Diseases of.—Synon.: Fr. *Maladies des Ovaires*; Ger. *Krankheiten der Eierstöcke*; *Krankheiten der Ovarien.*

In the article Abdomen, Diseases of, mention is made under one of the groups of diseases of the female generative organs, including the uterus and its broad ligament, the Fallopian tubes, and the ovaries. Under the heads Menstruation, Disorders of, and Hysteria, much information may be found upon subjects which might be included

among the diseases of the ovaries. But there remains something regarding the pathology, diagnosis, and treatment of ovarian diseases interesting to the physician, without entering upon the more surgical question of such cysts and tumours of the ovaries as call for tapping or ovariotomy.

In proceeding to estimate the frequency and importance of the diseases of the ovaries, we have to consider the wonderful series of periodical processes which go on in women every month for some thirty-five years; sometimes without any interruption by pregnancy, sometimes interrupted by many pregnancies, either carried on to the full period, or interrupted at different stages, followed by lactation for periods variously prolonged, perhaps suddenly stopped by the death of the child or by another pregnancy, attended by losses of blood of less or greater quantity, and ceasing usually from forty to fifty years of age, after more or less irregularity. We have to remember that at each menstrual period one or other ovary becomes swollen; that one or more of its ovisacs enlarges, opens, and permits the escape of the ovum it contained; that the fimbrial end of the Fallopian tube grasps the ovary, receives the ovum, and allows of its passage into the uterine cavity; that the uterus itself receives an increased supply of blood; and that its mucous membrane undergoes a series of exfoliative changes. We must consider, further, how these periodical processes are associated with much that is of supreme importance in the state of the nervous centres, and in the mental condition of woman; that the normal process, instead of recurring at regular intervals, and ceasing in a few days, may be abnormally prolonged, and may recur at most uncertain periods; and that evolution and involution may be both affected by pregnancy and lactation. When we bear in mind all these highly complex conditions, processes, and relations, the wonder is not that ovarian diseases should be frequent, but that so many women pass through life without suffering from them. If an ovary become swollen and tender, its blood-vessels over-distended, and extravasation or apoplexy of the proper ovarian tissue take place; or if blood, escaping into the peritoneal cavity, become encapsuled, or if it form a hæmatocele in the loose cellular tissue between the layers of one or both of the broad ligaments, we can only wonder that such an accident does not happen more frequently, and be prepared to recognise the effects of repeated slight extravasations. These are uneasiness in the abdomen, increasing to pain, more or less severe, want of sleep, and raised temperature, preceding discharge of blood from the uterus. Then follow swelling and tenderness in one or both groins, bearing down like labour-pains, recurring at intervals, with discharge of fluid or clotted blood or of membranous shreds; extension of pain to the loins, and irregular flow of urine—all symptoms so often observed as to be almost neglected. And if a vaginal examination is made, especially when combined with examination by the rectum, not only may one or both ovaries be felt larger and lower down than they ought to be, behind and on either side of the uterus; but they may be extremely tender on pressure, and there may be more or less evidence of peri-uterine extravasation. After repeated attacks of this nature, permanent hardening and enlargement of ovaries and uterus, and their impaired mobility, due to organisation of blood-clot or of plastic lymph, are among the most frequent pathological changes which the practitioner is called upon to treat.

The diseases of the ovaries, which will be specially alluded to in this article, are as follows: (1) Abnormalities; (2) Displacements; (3) Disturbances of Circulation; (4) Acute Inflammation; (5) Chronic Inflammation; and (6) Tumours, including Cysts.

1. **Abnormalities.**—Absence of the ovaries, or their imperfect development, may occasionally be inferred; and the presence of a third or accessory ovary, now and then observed in the dissecting-room and on the operating-table, may probably account for the recurrence of regular menstruation in spite of serious disease of both ovaries, or after the removal of both by ovariotomy.

2. **Displacements.** — Congenital or acquired displacements are also observed, as hernia into the inguinal canal, or prolapse into Douglas's pouch. *See* Ovaries, Herniæ of.

3. **Disturbances of Circulation.**—Hyperæmia, when not excessive, may be considered as an essential part of normal menstruation. A very little excess may lead to the formation of a large clot in an unbroken ovisac, or extravasation into the stroma of the ovary, constituting apoplexy; or between the layers of the broad ligament, or into the peritoneal cavity, thus forming peri-uterine or pelvic hæmatocele. In some cases apoplexy of the ovisacs is clearly traceable to torsion of the ovary upon its nutrient blood-vessels.

4. **Acute Inflammation.**—Acute oophoritis and peri-oophoritis are probably of much more frequent occurrence than acute orchitis in the male. The testicles are far more liable to mechanical injuries, but are probably not more liable to extension of the poison of gonorrhœa, or its sympathetic effects; and they are free from the periodical hyperæmia which may be regarded as the first step in the process of ovarian inflammation. This periodical hyperæmia, influenced by accidental sudden suppression of discharge of blood from the uterus, is the usual history of an acute attack of oophoritis.

Symptoms.—The symptoms of acute in-

flammation of an ovary are pain over the pubes, tenderness on pressure in one iliac region, irritation of the bladder, tenderness of the vagina, and pain on moving the cervix uteri, and on passing the finger behind and on one side of the cervix towards the sacro-iliac synchondrosis. In patients with lax tissues, by combined abdominal, rectal, and vaginal examination, the swollen ovary may very often be felt. If one ovary can be felt and moved, the patient at once complains of greatly aggravated pain.

Treatment.—The treatment should consist in absolute rest on the back, with the hips raised and thighs flexed; or on the side not affected, if dry-cupping glasses can be applied over the sacrum. Mustard poultices, or turpentine and chloroform liniment, may also be applied over the sacrum and on the iliac region. The bowels should be well cleared out, and small doses of blue pill and Dover's powder given frequently, with a sufficient quantity of bromide of potassium. Leeching the cervix uteri has been recommended; but the local disturbance caused by this method usually does more harm than the loss of blood can make up for. Sometimes the pain is so very severe that it may be necessary to give chloroform or some other anæsthetic, and repeat it more than once before relief is obtained.

5. **Chronic Inflammation.** — Chronic oophoritis, distinguished by those paroxysmal attacks of pain recurring at the menstrual periods commonly known as ovarian dysmenorrhœa, is a much more common condition than the acute form of the disease. And there can be little doubt that both amenorrhœa and menorrhagia may be often due to changes in the ovaries, which are the result of repeated attacks of subacute inflammation. Some turgescence of the mucous membrane of the uterus and Fallopian tubes is a condition attendant upon ovulation; and is physiologically or pathologically in close relation with the normal or abnormal process in the ovary. So far as anatomical examination teaches us, it is rare to find much change in the ovaries alone, without proof of what is called peri-oophoritis; adhesions between the surface of the ovary and the fimbriæ of the Fallopian tube or the tube itself; adhesions due to pelvic peritonitis; hardening and enlargement of the ovary itself; hard clots in some of the ovisacs; or, on the other hand, a shrivelling, contraction, or atrophy of the gland.

Treatment.—Whether the chronic form of the disease has succeeded an acute attack—non-puerperal or puerperal, or one or more attacks of gonorrhœa, or repeated abortions, or has merely increased in intensity or duration after repeated recurrence, the treatment must still be the same: namely, avoidance of known causes, rest, attention to the general health, counter-irritation, and the use of sedatives, especially conium, belladonna, and the bromides. In cases of distinct falling downwards of one or both ovaries, an elastic ring pessary, worn in the vagina for a few weeks, is sometimes of signal service. Hard pessaries are not well borne. When all other means fail, the operation of extirpating both ovaries must be seriously considered in consultation. We require more facts, accurately observed and faithfully recorded, especially as to the mortality, and to the results obtained by the operation when it does not prove fatal, and the state of the patient's health of body and mind for some years afterwards, before the true value of the operation can be estimated. But enough evidence has been already collected to prove that, after ordinary measures have failed, and morbid physical and mental conditions are clearly dependent on abnormal menstruation, and possibly upon morbid conditions of the ovaries, the physician would be fully justified in advising the patient or her friends to call for the aid of surgery. Unfortunately there has been of late years a deplorable tendency among a few specialists to mutilate women without any just cause. Women have been rendered sterile without explanation of any such result of the operation proposed to them. Many who have refused to submit to such treatment have recovered without it, have married, and borne children. Recoveries after an unnecessary operation have been recorded untruly as cures of the diseased condition, and many failures have been left unrecorded. It is not unnecessary to repeat protests against neglect of the true principles of professional honour, and against the recent abuse of an operation which may only occasionally be justifiable and valuable.

6. **Tumours.**—Of all the diseases of the ovaries, far more common than any malformation or displacement, even more commonly the cause of such suffering as to lead a patient to seek for medical advice than either the acute or chronic forms of ovarian inflammation, or than the ovaralgia or nervous hysterical form of ovarian irritation associated with dysmenorrhœa, and with various forms of eccentricity, and possibly of hypochondriasis, melancholia, or maniacal excitement—common though these conditions may be—cysts of one or both ovaries are the most frequent of all the diseases of these organs. So far as regards their pathological anatomy, for all practical purposes of diagnosis and treatment, they may be divided into *simple* or *unilocular*, and *compound* or *multilocular*—the former a dilated dropsical ovisac, the latter a proliferating cystoma or a dermoid cyst. A still more practical, if less scientific, division might be made into (1) *cysts*, and (2) *tumours* of the ovaries, including in the former division such simple or multiple cysts as from the preponderance

of fluid and small amount of cyst-wall, may properly be considered as ovarian dropsy—*hydrops ovarii*, or *hydrops folliculorum Graafii*; and in the latter such solid or semi-solid tumours as, under a general class of proliferating cystomata, include pseudo-colloid tumours, myxo-cystoma, cystoid adenoma, sarcoma, fibroma, papilloma, carcinoma, and (as a separate class) dermoid cysts. The histogenesis and the microscopic character of these varied forms of disease must be studied by the aid of special treatises or monographs. Here their clinical history is of chief importance.

Symptoms and Diagnosis.—Clinically the main points for consideration in cases of fluctuating abdominal tumours are whether the fluid is contained within a cyst, or whether it is in the peritoneal cavity, either free or limited by visceral adhesions. In solid tumours their seat and nature must be investigated. *See* Ascites.

In the diagnosis between fluid in an abdominal cyst and in the peritoneal cavity, important points are that the limit of fluctuation as recognised by palpation, and the limit of dulness as ascertained on percussion, exactly correspond when the fluid is encysted. The wave of fluid cannot be made to pass beyond the line of dulness on percussion. But, when the fluid is free, the resonant intestines are floating in or on it, and fluctuation may be detected where percussion gave a resonant or tympanitic note. The wave of fluid is not stopped by any cyst-wall.

Chemical and microscopical examination.—If tapping have been resorted to, in order to give temporary relief to urgent symptoms, or to complete a doubtful diagnosis, chemical and microscopical examination of the fluid affords valuable information. The albumen in the serum secreted by the peritoneum is ordinary albumen, which is coagulated by heat, and will not redissolve in double its volume of strong boiling acetic acid. The albumen secreted by the epithelial layer of an ovarian cyst is that secreted rather by mucous than by serous membranes, known as metalbumin and paralbumin, which (like true albumen) is coagulated by heat, but (unlike true albumen) is redissolved, or converted into a translucent gelatiniform liquid, after having been boiled in double its volume of strong acetic acid. Then on examining the deposit which subsides after ovarian fluid has been at rest for some hours, there may be found in the field of the microscope the nuclei of the epithelial cells which line the interior of the cyst. The scales are thrown off, the cell-walls break down, and the nuclei remain. These are the so-called 'ovarian granule-cells' of Nunn, Bennett, and Drysdale, and are characteristic of innocent growth. In addition to these, there are found in malignant growths characteristic groups of cells of different sizes, described about the same time by Foulis and Thornton as large pear-shaped round, or oval cells, containing a granular material, with one or several large clear nuclei, with nucleoli and a number of transparent globules or vacuoles. The great variety in size and shape of the cells composing the groups is the characteristic feature. When these large groups are found in fluid removed from a cyst, it is extremely probable that a malignant growth projects into the cavity of the cyst. When the groups are found in peritoneal fluid, there is either some malignant growth, or an ovarian cyst of a malignant character has burst into the peritoneal cavity. Some of the cells have planted themselves upon the surface of the peritoneum, where they have grown and multiplied. Some observers believe that when such groups of cells are found in fluid removed from a cyst or from the peritoneal cavity, the evidence of the malignant nature of the disease is so strong that no other than palliative treatment is justifiable. But microscopic knowledge has certainly not yet reached such perfection as to justify a surgeon in refusing to attempt to save life by removing a tumour, if it can be removed, even if it be characterised by the formation of such groups of cells as have been described. Several such ovarian tumours have been removed after they had burst, and after several tappings of the peritoneal cavity, with the happy result of recovery from the operation and subsequent good health. After the removal of a proliferating cystoma recurrence of the disease has been observed, but there is good ground for believing that recurrence is exceptional.

Semi-solid tumours.—Semi-solid ovarian tumours are more common than simple cysts. Instead of a smooth uniform surface, irregularities may be felt, due to cysts, or groups of cysts, of different shapes and sizes, or to thickening of portions of the wall of the main cyst. The wave of fluctuation is interrupted by septa in different directions; and hard nodules, or bone-like projections, may perhaps be detected. Occasionally a deep sulcus between two portions of a semi-solid tumour, with resonant intestine in the sulcus, may lead to doubt whether both ovaries are not affected.

Solid tumours.—Ovarian tumours which are entirely solid, not fluctuating in any portion of them, are very rare, but still are occasionally met with, both as innocent fibroma and as true cancer.

Adhesions.—Any ovarian tumour—cystic, solid, or semi-solid—may be free from adhesion to the abdominal wall or to the omentum or viscera, or may be adherent anywhere within the abdominal or pelvic cavities. But as the result of ovariotomy is very little affected by the presence or absence of adhesions, a very minute diagnosis of the nature and extent of adhesions is not of much

practical importance. Still, if there are firm adhesions low down in the pelvis, fixing the uterus, rectum, and bladder together, or fusing them, as it were, into one mass with the ovarian growths, ovariotomy should not be performed, or only to relieve threatening danger, and after a very guarded prognosis.

Inflammation, hæmorrhage, and *gangrene*. Any ovarian cyst, simple or compound, may be the seat of inflammation either on its surface, when the symptoms do not differ from those of peritonitis, or in the cyst-wall or lining membrane, when (without any peritonitis) there may be pain and considerable fever, sometimes followed by rigors and suppuration. Hæmorrhage into one or more of the cyst-cavities may lead to all the symptoms and effects of internal hæmorrhage. Or the whole or portions of the tumour may become gangrenous, from a twisting of the pedicle obstructing the circulation of blood in the vessels of the tumour. In some cases twisting of the pedicle may be followed by a complete separation of the tumour from its ordinary supply of blood. In this condition the tumour is nourished by vessels in the omentum, abdominal wall, or some other structure adherent to the peritoneal coat of the tumour, if the woman's death is not speedily caused by gangrene of the growth.

Other abdominal tumours.—The abdominal tumours most frequently mistaken for ovarian tumours are fibroid or fibro-cystic tumours of the uterus, and tumours or cysts of the spleen, liver, or kidney. Pregnancy, either normal or extra-uterine, may also be mistaken for an ovarian tumour, or may be present at the same time. It is not rare to find a woman with an ovarian or a uterine tumour to be also pregnant; so that the ordinary signs of pregnancy must be borne in mind in examining any woman who has an abdominal tumour. And the frequency of fæcal accumulations, or of tympanitic distension of the intestines, with thick or rigid abdominal walls and a fat omentum, must also be remembered and excluded, as well as fatty or fibro-fatty tumours which may form in the omentum, or consist of hypertrophied appendices epiploicæ, and fibro-plastic growths, from any part of the peritoneum or sub-peritoneal cellular tissue. Peritoneal hydatids, or hydatid cysts of the liver, spleen, or omentum, retro-peritoneal abscesses, pelvic cellulitis followed by abscess, distended bladder, pelvic hæmatocele, enlarged mesenteric or lumbar glands, aortic aneurysm, and enchondroma, are all conditions which must be borne in mind in cases where the ordinary signs of an ovarian cyst or tumour are not sufficiently characteristic to exclude doubt.

But the most frequent source of error is cancer of the peritoneum, not necessarily involving the ovaries, although these organs may not be free from the disease. In some cases the uterus, and both ovaries, and the peritoneum everywhere become covered or infiltrated with cancerous deposits or growths, and in nearly all cases there is considerable accumulation of fluid in the peritoneal cavity. If the coats of the small intestines are involved, the very characteristic signs are manifest of movable tumours, which are both hard and resonant, and which on being pressed or kneaded gurgle under the fingers. In any case of abdominal tumour, with or without peritoneal fluid, where the loss of flesh and strength is rapid, although the tumour may not be large, where there is much pain, and the patient is subject to vomiting or diarrhœa, the diagnosis of intra-abdominal cancer generally proves too true.

Prognosis and Treatment.—1. *Medical.* It must be confessed that the medical treatment of ovarian cysts and tumours in a curative sense is quite hopeless. In cases of supposed simple cysts, where powerful purgatives and diuretics have been followed by disappearance of the fluid, the true explanation has been either a mistake in diagnosis, or an accidental rupture of a thin cyst. In the compound cysts, or the more solid tumours, iodides, bromides, mercurials, and every other remedy that has been tried, have proved useless at the best, and have often injured the general health of the patient without affecting the morbid growth. Beyond attending to the general health of the patient, and palliating any urgent symptom, the chief aim of the physician should be to do no harm, to encourage a cheerful state of mind in his patient by the assurance that the disease is curable, and whilst he postpones surgical treatment so long as it is not clearly necessary, he should not allow a patient to wait so long that, after unnecessary and prolonged suffering, she should fall into a condition unfavourable for the result of an operation.

2. *Surgical.*—If, after exposure to cold, or as the result of a blow or fall, a patient with an ovarian tumour presents the signs and symptoms of inflammatory changes in the tumour or in the peritoneum, rest, fomentations or poultices, and opiates are indicated. If very severe symptoms point to hæmorrhage or cyst-rupture, immediate ovariotomy may afford the only hope of saving life.

In considering the very important question how long a patient should be left to ordinary hygienic or medical treatment without any assistance from surgery, it may be said: 'So long as the patient does not suffer much pain, is not annoyed by her size and appearance, has no great difficulty in locomotion, does not suffer from injurious pressure on the organs of the chest, abdomen, or pelvis, and so long as the heart and lungs, digestive organs, kidneys, bladder, and rectum perform their functions tolerably well, surgical treatment is seldom called for. It is only a pro-

jected marriage, or a necessary voyage, or some such family circumstance, that may justify or render expedient earlier resort to surgical aid. Under ordinary circumstances the surgeon would not interfere until an ovarian tumour either distressingly deforms a patient, or seriously impedes her locomotion, or prevents the free action of heart or lungs, or obstructs the circulation through the large veins of the abdomen, or, by deranging the digestive organs, leads to emaciation and weakness, or by its pressure causes pain, loss of rest, or mechanical obstruction to bladder or rectum.' These are the rules laid down in 1872 by the writer of this article. Subsequent experience of the ill effects of delay, and of the diminished and diminishing mortality of ovariotomy, leads to the conclusion that these rules rather err on the side of over-caution and too long delay; and that the welfare of most patients is better promoted by advising an earlier adoption of surgical treatment, and probably the removal of an ovarian tumour as soon as its nature and connexions can be clearly ascertained, and it is beginning in any way physically or mentally to do harm.

In cases of single cysts the question of palliative treatment by tapping, or the radical cure by ovariotomy, must be seriously considered. And when a cyst is really single, the removal of the fluid not only gives great relief for a considerable period, but in some cases fluid does not collect again for several years, sometimes never. Even when a cyst is not absolutely single, but contains one cavity so large that smaller cavities are practically insignificant, tapping may give sufficient relief to warrant its recommendation in cases where patients desire to postpone any more hazardous operation. But in all cases it should be done with the strictest antiseptic precautions against the entrance into the emptied cyst-cavity of atmospheric air possibly containing some germ or material which may set up putrefactive or infective changes within the body.

Tapping by the abdominal wall, vagina, or rectum, alone or followed by pressure, by drainage, by injection of iodine, by incision, or by the formation of a permanent communication between the cyst-cavity and the peritoneal cavity, in these days can only be regarded as substitutes in cases where ovariotomy is rejected by the patient, or where the surgeon finds that the ovarian tumour cannot be removed. In a very large majority of cases the only hope of cure is in ovariotomy.

Question of Ovariotomy.—When it has to be considered in consultation whether a patient should be advised to submit to ovariotomy or not, the chief points for discussion are: 1. How long is she likely to live if left alone, or relieved by palliative treatment only—hygienic and medical—or by tapping? 2. What is the risk of ovariotomy at the average rate of mortality, and how far is the risk in the one patient who is the subject of consultation likely to be above or below the general average?

In reply to the first question, it is believed that after an ovarian tumour has attained such a size as to inconvenience a patient she rarely lives four years—even if relieved by occasional tapping—and that, with due allowance for a few exceptional cases of many years' duration, two years would be the full average expectation of life. Thus, even at the best, two years of invalid life is what is lost, even if ovariotomy be done and is unsuccessful.

The average risk of ovariotomy in a large number of cases, including the most and the least favourable, has been diminishing for many years past; and the diminution since about 1875 has been much greater than before the adoption of antiseptic precautions during the operation. Before 1860 so many unsuccessful cases were concealed, and the numbers who died, of the cases reported, were so great, that the calculated mortality of about 50 per cent., or half the patients operated on, is probably far too small, and it would be more correctly estimated at 70 to 80 per cent. Since 1860 it has been gradually diminishing from 35 to 15 per cent.; and since 1878, when antiseptics came into general use here and in Germany, it has fallen below 10 per cent., whilst well-founded hopes are entertained of a still smaller mortality. It may be said in 1893 that ovariotomy is by far the most successful of any of the 'capital' operations of surgery. In cases which before operation are looked upon by an experienced operator as favourable, the expectation of success as at least 95 in 100 will probably be justified by the result.

Whether any one patient is likely to have more or less than the probability of ten to one in her favour must depend upon her general health. For the rule holds good, that, while the easy removal of small free tumours from women with a feeble heart, or unsound lungs, kidneys, or liver, or shattered nervous system, may hasten death—so may very large adherent tumours be removed with extreme difficulty from sound, healthy women, and complete recovery may follow, without fever or any unpleasant symptoms; and, most satisfactory of all, perfect health may afterwards be enjoyed for many years, the operation leading to no appreciable modification in subsequent pregnancies or parturition. The removal of one ovary does not appear to affect the number of pregnancies, nor the sex of the children, nor the occurrence of twin pregnancy; and it is quite exceptional to observe that the removal of both ovaries leads to obesity, or to any other mental or bodily peculiarity.

T. Spencer Wells.

OVARIES, Herniæ of the.—Displacements of the ovaries, apart from those occasioned by ovarian disease, were generally ignored until comparatively recently, and still receive less consideration than their pathological importance demands; being amongst the most frequent causes of many of the special troubles which come before us in gynæcological practice. In the majority of cases these displacements occur downwards into Douglas's space, and in such instances the left ovary is the one usually displaced. The next most frequent forms of ovarian herniæ are those occurring in the inguinal regions, either above Poupart's ligament, or, as is more commonly the case, following the canal of Nuck downwards and forwards and presenting in the labia. In the first named, or directly downward displacement, the ovary, on vaginal examination, may be discovered in the recto-vaginal fossa as a small ovoid, firm, elastic, and highly sensitive tumour, bulging into the post-cervical *cul de sac.*

Ætiology.—Although in some instances congenital, ovarian herniæ more usually occur in patients whose abdominal parietes have been relaxed and viscera compressed by repeated gestation, or want of due support after parturition. They may also be induced by causes similar to those of other herniæ, such as the violent muscular efforts of the second stage of labour, lifting a heavy child, or straining at stool. In displacement downwards into Douglas's space, the cause of the protrusion is, however, generally gynæcological rather than obstetric, the result of the *vis à tergo* of abdominal or uterine tumours, or of the tension on the appendages occasioned by displacements of the uterus.

Symptoms and Diagnosis.—Ovarian displacements, when inguinal, may be mistaken for enlarged glands, or as an enterocele or epiplocele; when labial, for other tumours in that situation; when downwards, for pelvic abscess or hæmatocele, retroversion or retroflexion, or for a fibroid growth from the posterior uterine wall. The sudden occurrence of a small ovoid tumour, possessing the physical characteristics just referred to and located in one or other of these situations, accompanied by constitutional and nervous disturbance, with a peculiar dull sickening pain, aggravated into acute suffering at each menstrual epoch, and a coincident increase of size then manifest, together with the intense tenderness or nausea generally evinced during any examination of the part, are sufficient to enable a correct recognition of the nature of the case to be made by any competent gynæcologist.

Treatment.—When the ovarian hernia takes place at either of the abdominal rings, it may in some instances be reduced by taxis. In the majority of cases, however, these displacements are already irreducible when discovered; and even in the cases in which reduction is possible, the retentive pressure of an ordinary truss is too frequently neither endurable nor effectual. In such instances the extruding ovary should, if feasible, be protected from further protrusion or external injury by a well-fitting hollow truss. But before this an attempt should always be made to lessen the local hyperæsthesia of the generally hypertrophied displaced gland by topical sedative applications, and, if necessary, by leeching, &c.; whilst the constitutional irritation almost always present in such cases should be allayed by suitable constitutional treatment. When, however, these measures prove ineffectual in relieving the persistent, dull, worrying, aching pain so commonly associated with chronic ovarian hernia, and which at each monthly period in these cases becomes accentuated or acute—when, too, the patient's health is endangered by the nervous disturbance and constitutional irritation, we should fall back on extirpation as the only resource available. But this treatment should be regarded as exceptional; nor is the performance of oophorectomy under these circumstances by any means devoid of risk, or to be undertaken without urgent necessity, and until a fair trial has been first made of other remedial or palliative measures.

With regard to the treatment of prolapse of the ovary into Douglas's space, this caution is especially applicable. In considering the management of this displacement, its causes must be carefully borne in view. Pressure from above downwards of a uterine or ovarian tumour, or the traction of a uterine displacement on the broad ligaments, must be removed or relieved before any successful reposition of the prolapsed ovary can be made. When the dislocation is due to some accidental circumstance, or to a relaxed state of the parts occasioned by constitutional causes, we may, with greater probability of permanent success, attempt to return the displaced viscus and retain it *in situ.* For this purpose the patient—being first etherised in order to permit of the necessary manipulation of the generally highly sensitive and tumefied ovary —should be placed in the left lateral semi-prone position, when by gentle, steady, conjoint digital pressure through the rectum and vagina, upwards and forwards, we may be able to lift the extruded ovary out of the post-cervical recto-vaginal fossa, and to push it up into its normal position, where it may then be retained by a suitable support. Failing the possibility of such re-position, however, if the local and constitutional effects of the displacement are urgent and otherwise irremediable, the practitioner as a *dernier ressort* must remove the ectopic gland.

Thomas More Madden.

OVERLAYING.—Synon.: Fr. *Étouffer un Enfant.*—Overlaying is an accident which, it is alleged, not infrequently happens to young children, whereby they are killed by suffocation. On an average rather more than four hundred children per annum are registered in London as dying from 'overlying' in bed. The Registrar-General in his report for 1890 states that 1,544 children, mostly in the first year of life, died from 'suffocation in bed'; that this mode of death is on the increase; that it is more frequent in the winter than in the summer; and that the proportion of deaths due to this cause is more than twice as high on Saturday night as on any other night in the week. The only explanation for the pre-eminence of Saturday is the fact that on this day wages are paid and drunkenness is common. The *post-mortem* signs of overlaying are those of suffocation. Evidence that a child has really died from this cause is afforded by (1) the *post-mortem* appearances of death from asphyxia; (2) the absence of any other mortal disease; (3) the absence of evidence of any cause of asphyxia other than overlaying.

The statement that a child has been overlain should be received with caution. It is reasonable to suppose that a vigorous child would escape from a suffocating position beneath the bed-clothes, or the body of its nurse, by its own efforts; or at least succeed, by its crying and struggling, in waking its nurse. On the other hand, a very weakly child, whose lungs possibly have only partially expanded, might be killed by a very trifling cause, such as the position of its mouth and nose against the body of its nurse, or the accidental temporary obstruction of its air-passages by the bed-clothes. A medical witness, before committing himself to a theory of death from overlaying, must consider all the points alluded to above, and must take care not to bring a charge of almost criminal carelessness against a careful nurse, or allow an act of wilful murder to pass under the guise of accidental death.

G. V. Poore.

OXALIC ACID, Poisoning by.—*See* Poisons.

OXALIC ACID DIATHESIS—OXALATE OF LIME CALCULUS.

1. Oxalic Acid Diathesis.—Synon.: Oxaluria; Fr. *Oxalurie*; Ger. *Oxalurie*.

Ætiology.—Oxalic acid, when it occurs in the urine, may be derived from various sources: (1) It may come from certain articles of the vegetable kingdom taken as food. (2) It may be derived from imperfect metamorphosis of the waste tissues of the body. (3) It may be due to the conversion of urea and uric acid after the secretion or the emission of urine. (4) It seems to have been proved that oxalic acid sometimes exists in the blood, and may then simply be eliminated by the kidneys.

Characters and Composition.—Oxalic acid in the urine is always found combined with lime, and is recognised thus: (1) As minute octohedral crystals with cross markings. These crystals assume apparently different shapes, according to their varying position in the field of the microscope. (2) As spheroidal, ovoid, or dumb-bell submorphous masses. These latter may be mistaken for somewhat similar bodies composed of lithates; but the colour of the lithates, and the almost invariably concurrent presence of the octohedra, will distinguish them (*see* Microscope in Medicine, fig. 107). The urine containing oxalate of lime is always acid, generally of an amber tint, and contains a faint cloud of mucus. This cloud, however, may be so slight as to be unnoticed, and then the presence of oxalates is apt to be overlooked.

Symptoms.—However derived, the presence of oxalate of lime in the urine frequently, or in any considerable amount, cannot but arrest attention and suggest the question: Is there any special condition of the system dependent on or associated with this occurrence? In other words: Is there any peculiar habit of body to which the term 'oxalic acid diathesis' can be rightly applied? Prout, and especially Golding Bird, so fully described the symptoms of nervous exhaustion, dyspepsia, and hypochondriasis, which are said to characterise this so-called diathesis, and so fully impressed the professional mind with the clinical association of these symptoms with—if not their actual dependence on—oxaluria, that the more accurate observations of Dr. Beale, Beneke, and Sir William Roberts, have scarcely yet succeeded in dissipating the error. These observers have proved that, in the majority of cases in which the characteristic symptoms are present, no oxalates are found in the urine; and, conversely, where oxaluria is most pronounced, the symptoms are absent. Oxalate of lime in the urine is often found in persons enjoying good health. From what has been said of its ætiology, its presence is explained in various chronic diseases, such as phthisis, chronic bronchitis, cardiac lesions, &c., in which oxidation is retarded. So, too, oxaluria is present in many conditions of deranged digestion and mal-assimilation, and in diseases which lower nervous tone and power.

Treatment.—The frequent or persistent presence of oxalate of lime in the urine, when no organic disease is present, is not easy to remedy. Dietetic habits and the general health must be watched. Rhubarb and other vegetable articles which contain oxalic acid should be avoided, and strict moderation and simplicity in food and drink enforced. Dyspepsia may be treated with the usual remedies—alkalis and the vegetable tonics, and sometimes with mineral acids and

iron. Sedentary habits should be exchanged for brisk exercise and sea air. In a word, attention to the health of mind and body, rather than any special drug treatment addressed to the urinary deposits, is required and will best succeed.

2. **Oxalate of Lime Calculus.**—Description.—Mulberry or oxalate of lime calculus is usually of a dark brown, sometimes almost black, colour; generally ovoid or spheroidal in shape; with a rough and tuberculated exterior; and of a hard compact interior. The absolute nucleus is composed of dumb-bell crystals, united by molecular coalescence in, and through the medium of, some viscid organic matter. The influences which control this deposition and growth of calculi have been much elucidated through the researches of Dr. Carter and Dr. Ord, but need not be specially described here. *See* Calculus.

The great insolubility of oxalate of lime favours the chances of its deposition in the renal tubules. It has been detected in the kidneys of the fœtus; it is especially liable to occur during childhood; and this liability decreases as age advances. In England calculi composed entirely of oxalate of lime are rare in the adult, but in India they are comparatively frequent. Mulberry calculus in the young causes intense suffering; but in the adult, notwithstanding the formidable tubercles and rough exterior, the symptoms of stone are often mild; not improbably because these projections become entangled in the muscular columns of the bladder, and the calculus is thereby fixed in position. The symptoms of renal calculus are fully described in another article. *See* Renal Calculus.

Treatment.—Microscopic mulberry calculi, were it possible to detect their existence, could probably be washed away and carried off by diluents and diuretics; but a palpable stone demands surgical treatment only.

W. Cadge.

OXYURIS.—*See* Entozoa.

OZÆNA (ὄζαινα, a fœtid polypus in the nose; from ὄζω, I have a smell).—*See* Nose, Diseases of.

P

PACHYMENINGITIS (παχύς, thick; and μῆνιγξ, a membrane).—A synonym for inflammation of the dura mater of the brain and of the spinal cord. *See* Meninges, Cerebral, Diseases of.

PAIN.—Synon.: Fr. *Douleur*; Ger. *Schmerz.*

Definition.—Pain is the representation in consciousness of a change produced in a nerve-centre by a certain mode of excitation. It would seem that stimulation of special nerve-fibres or special nerve-centres, and not a mere exaltation of the normal functioning of the sensory apparatus, is necessary to the production of pain. For it will sometimes happen, in disease, that whilst the faculty of perceiving painful impressions made upon certain portions of the skin is wholly, or in great part, lost, touch is felt as well as in health. On the other hand, in hyperalgesia of the surface, where the slightest impression produces exquisite pain, the power of tactile discrimination is actually diminished.

Ætiology and Pathology.—Pain is excited by many agencies applied to the skin—mechanical, thermic, chemical, electric, pathological. Of these it is probably only the last which are able to produce pain when applied to the viscera, bones, and blood-vessels. The situation of the stimulus exciting pain may be at any part of the sensory apparatus, from the end-organ in the skin to the central ganglion; but the feeling of pain is always referred to the periphery of the sensory fibre, no matter what portion of the sensory tract has received the irritation. As regards pain, therefore, which is referred to some part of the interior of the body, it must be remembered that the cause (always some pathological agency) may be operating either upon the termination of a nerve, its trunk, or upon the nervous centre in the spinal cord or superior ganglia. There may be encroachments upon the structure of the nerve-fibre or ganglionic centre, arising from hyperæmia, effusion, or growth in neighbouring tissues.

Pathologically, pain is of at least twofold importance: 1. It causes distress and exhaustion of nervous energy, interferes with sleep, interrupts the appetite and digestion, so that the nutrition of the body is damaged, and thus, if long-continued, it can lead to changes shortening existence; or it may possibly be so severe as of itself to occasion death. 2. Its aid in diagnosis is frequently of higher value than that of any other single symptom.

Varieties and Diagnosis.—It may be useful to refer briefly to a few examples of the diagnostic importance of pain.

Pain in the head.—When of a continuous, dull, aching character, pain in the head may be due to rheumatism of the scalp, and this is especially likely if it be increased by bending the head down. A headache of similar character, and affecting the forehead, may be referred to, and be dependent on gastric derangement. Focussed in one spot, either on the head or face, and darting from that spot, if sharp and paroxysmal, it is likely to be neuralgic. If, in addition, it be accompanied by vomiting and giddiness, it may indicate megrim. Now, megrim, much more often than not, endures for a day only at a time, or a little more, to be repeated after an interval of days or weeks. If, therefore, these symptoms be continued beyond the period of a day or two, they should always be regarded with anxiety, as probably connected with brain-mischief. The use of the ophthalmoscope is most important here. If optic neuritis be discovered, the pain is dependent either on intracranial disease or upon Bright's disease. Should pain in the head be accompanied not only by vomiting and giddiness, but by squint, or some other evidence of a localised paralysis of a cranial nerve, it is almost certainly due to intracranial disease of a coarse kind—tumour, aneurysm, abscess, hæmorrhage, or meningitis. In cases of more or less complete hemiplegia from vascular changes and thrombosis, a varying amount of pain in the head will often remain after the apparent recovery of the patient. Whilst this persists, a guarded prognosis is essential, for much more often than not further mischief will follow before long. In all cases of persistent pain in the head, the urine should be carefully examined, not only for albumen, but also for sugar. Pain of a severe kind, especially apt to attack the back of the head, is often found in the course of Bright's disease. It will then be accompanied by albuminous urine; and the ophthalmoscope will very likely show albuminuric neuro-retinitis. There is also a form of more or less continuous headache, with occasional violent exacerbations, which accompanies glycosuria.

A recurrent pain in the head, of excessive violence, and described as a feeling as though the bones were being crushed, whilst it may occasionally be due to rheumatism, is far more often dependent upon syphilis. Generally speaking, persistent pain in the head, in a person unaccustomed to it, is a symptom which should always be regarded with anxiety, and the use of the test-tube and ophthalmoscope should never in such circumstances be omitted. This should especially be insisted upon if the patient be a female, and if certain concomitant symptoms incline the observer to believe the affection to be hysterical.

In obscure cases the possibility of the toxic influence of lead in causing pain in the head should not be forgotten.

The pain in the head which accompanies chlorosis is often fixed in one spot, and described by the patient as resembling a nail being driven into the head. This symptom not infrequently accompanies hysterical conditions. The pain in the head complained of by school children, as attacking them in their studies, is very often due to some abnormality of refraction, or weakness of certain muscles of the eye, which needs the help of an ophthalmologist to investigate. Pains in the head of a darting, shooting character, are sometimes associated with locomotor ataxy.

Pain in the neck.—This is not at all uncommon, and is due most commonly to rheumatism, probably affecting the large muscles. It is possible, too, that in many cases it depends upon irritation of the loose connective tissue which enables one muscle to glide over another, and which is really an expansion of the lymphatic system. Uric acid, or some equivalent, becoming deposited in this lymphatic space, will excite a little subacute inflammation, and produce a very acute pain. The diathesis of the patient should be inquired into, his urine and evacuations observed, and his mode of living investigated. There may be, too, sometimes pain in the neck from neuralgia. This will be distinguished by its paroxysmal character, and its being independent of muscular movement. Neuralgic pain in the neck is usually accompanied by pain in the district of one or other of the divisions of the brachial plexus in the arm. It must be remembered that pain in the neck may be the first indication of either caries or rheumatoid arthritis of the cervical vertebræ. It may also be associated with an eruption of herpes zoster.

Pain in the chest.—This may be referred to the chest-wall, or to the interior of the cavity. In the former case it is necessary to determine whether the pain be due to muscular rheumatism, syphilitic periostitis, intercostal neuralgia, or the encroachment of an aneurysm or a tumour. Absence of febrile action, as shown by the thermometer, and the entire dependence of the pain upon movement, point to the first of these causes. A node perceived by the finger upon the sternum, clavicle, or ribs, would indicate syphilitic periostitis. The character of the pain, and the presence of tender points, coupled very probably with a history of previous neuralgic attacks in some other part of the body, suggest intercostal neuralgia. Physical examination will detect or exclude aneurysmal tumour. Pleurisy causes a pain referred to the chest-wall, which, as it is particularly marked when the patient coughs, may be confounded with muscular rheumatism or intercostal neuralgia. The elevation of temperature by which pleurisy is accompanied, and the absence of local tenderness,

will ordinarily distinguish it without difficulty, even before there are any auscultatory signs. Continued dull pain deep in the chest may indicate an intrathoracic growth, abscess, or aneurysm. Careful physical examination and observation are the means by which the diagnosis of these conditions can be made.

Pain is often experienced about the heart more or less early in the course of acute rheumatism. It may be dependent upon commencing peri- or endocarditis, which will be disclosed by the stethoscope. There is a dull, more or less constant pain about the heart, that occurs in conditions of nervous debility, and is not connected with organic disease of the organ. There is also a rather sharp pain just under the mamma, accompanied by cardiac palpitation, which is often complained of by epileptics, and by persons affected with hysteria. It is not accompanied by any evidence of organic change in the heart, and its origin is probably in the central nervous system. Pain in the heart, of an extremely sudden character, as though the muscle were being grasped, and accompanied by intense apprehension of death, with facial pallor and some dyspnœa, may point to angina pectoris. The pain is not confined to the heart, but extends to the left arm, and to various parts of the chest (*see* ANGINA PECTORIS). The pains in the chest which accompany various diseases of the lungs and pulmonary tubes will require to be investigated with reference to these conditions.

Pain in the spinal column.—Acute pain and superficial tenderness of any of the vertebral spines is a symptom, not of disease of the spinal cord, but of a peculiar state of nervous exhaustion. It is common in hysterical persons, and in others who have from any cause become greatly debilitated. As a rule, there is very little pain in the spine in diseases of the cord unattended by disease of the bony spine. In spinal meningitis the patient usually only complains of pain on movement, and especially if he endeavour to turn over in bed. Light pressure upon any part of the vertebral spines commonly causes no complaint; there may be, however, some uneasiness complained of when they are strongly percussed. Pain of an encircling kind, in a sort of band in the wall of the chest or abdomen, accompanied by what is often described as a 'bloated feeling,' is a serious symptom, and points to myelitis. There should be, however, some other confirmatory symptoms, ere this view is decisively fixed upon. In such a condition there would probably be found more or less weakness of the lower extremities, and possibly some cutaneous anæsthesia below the band of pain. It may happen that an aneurysm encroaches upon the spinal vertebræ, or a malignant growth invades some of them. In such conditions there is often constant and excessive pain, with, not uncommonly, a good deal of tenderness of the surface. The possibility of these conditions should always be borne in mind.

In commencing caries of the vertebræ a 'stinging' pain is often complained of in the chest-wall, and pain may also be complained of on pressing somewhat heavily upon a vertebral spine. In such a case, too, the act of stooping and lifting weights, or of jumping to the ground, is apt to cause complaint of pain in the spinal column.

Pain in the abdomen.—This may, like pain in the chest, be referred to either the abdominal wall or cavity. There may be inflammation and abscess in the abdominal wall. There may be neuralgia of the superficial branches of the lumbar plexus, in which case the pain is paroxysmal and sharp, and may be accompanied by herpes. But pain in this situation is more often myalgic, and will be found to correspond to the insertion of some abdominal muscle which is subject to overstrain or fatigue.

Acute abdominal pain referred to the contents of the belly may be dependent upon internal strangulation of the bowel, in which case it will be accompanied by vomiting, constipation, and probably by abdominal distension, with marked peristaltic writhings of the intestines. Or the cause may exist in a hernia which is strangulated. The symptoms in this case will be much like those above described, and therefore it is in all cases of acute abdominal pain with constipation absolutely necessary to make, first of all, a thorough examination, to ascertain that no hernial tumour is to be found. If pain in the abdomen be accompanied by tenderness on pressure, and be increased by coughing, there is probably peritonitis. In such a case the pulse will be found quick and small, and the temperature somewhat, but not necessarily much, raised. The patient will prefer to lie on the back with the knees bent; and the face will betray anxiety. In hysterical women great abdominal pain and tenderness is often complained of, and it is sometimes not very easy to distinguish this from peritonitis. It is best done by engaging the patient's attention, and noting that there is then no evidence of tenderness at a point which had been previously exceedingly painful. The pain and tenderness may be due to enteritis or perityphlitis, in which case there will be obstinate constipation, a tympanitic state of the whole intestine or the cæcum, and most probably vomiting. Cancerous tumours of various abdominal organs will have to be diagnosed by careful palpation, and discriminated from fæcal accumulation. Colic due to the poison of lead, causing violent abdominal pain without rise of temperature, requires to be distinguished from the symptoms which mark the passage of a

biliary calculus. Extreme suddenness and severity characterise the latter, and there is usually more vomiting in the passing of a gall-stone than in colic. But the history will have to be investigated; and the evacuations, if any be passed, should be examined. The absence of a blue line on the gums should be ascertained ere the possibility of the existence of lead colic is abandoned.

Pain in the loins and back.—There are many conditions which give rise to pain in these situations, and which require to be borne in mind in examining a patient. Congestion of the kidneys, or nephritis, will be shown by the scanty, high-coloured urine, containing albumen and probably blood. Renal calculus will be attended by unilateral pain in the loin, following the direction of the ureter, and affecting the corresponding testicle. It is paroxysmal in character, and often horribly severe. The urine will be likely to contain blood, and possibly pus, and will be passed very frequently. As between such a condition and the presence of an abscess or morbid growth in the kidney, the points of diagnosis are not strongly marked, and careful observation will be requisite in order to form an opinion. The presence of a bad stricture in the urethra, by causing retention and over-distension of the bladder with urine, will cause pain referred not only to the hypogastric region, but also to the back.

Lumbago is characterised especially by inability of the patient to rise from his chair without the greatest distress, and only slowly and with difficulty. It may depend upon rheumatism of the muscles, or, still more probably, upon sub-acute inflammation of the connective tissue between the muscles. Or it may be neuralgic in character, in which case it will be acutely stabbing, paroxysmal, and independent of muscular movement.

Pain in the back is frequently caused by flatulent distension of the bowels, and by accumulation of retained fæces. It may be dependent upon a tumour connected with the bowel (especially likely in the sigmoid flexure and rectum), which may or may not be felt by external palpation, or reached by the observer's finger introduced *per anum*. Nor must it be forgotten that an abscess in the wall of the rectum will cause long-continued and severe pain in the back. It is well to remember that an undiscovered hernia (not strangulated) may give rise to little or no inconvenience except pain in the back. So likewise flexions and morbid growths of the uterus, and ulcerations about the cervix, may be the cause of pain, as well as the approach of the catamenial period, which in some women is the cause of great pain in the back.

Pains in the extremities.—These may be due to neuralgia, in which case they will be found to occupy the district of one or more branches of nerves, and to be paroxysmal in character. The pains which affect the extremities and the trunk, but especially the legs, in the early stage of locomotor ataxy, are peculiar in this. A patient who has little complaint to make of his health, will every now and then be kept awake all night, and incapacitated in the day, by sudden, sharp, lightning-like pains darting through one or more limbs, and often severe enough to make him call out. They will occur in paroxysms, lasting hours, days, or, less often, weeks; and will subside as suddenly as they began. With such symptoms the patellar tendon reflex should always be tested. Other pains affecting the extremities are rheumatic; or of the nature of the gnawing and aching pains which occupy the joints in acute inflammation from any cause, including rheumatism, and in arthritis deformans. The joints may also be the seat of pains of a neuralgic character.

A most important contribution to the diagnostic value of pain will be found in a paper by Dr. Head 'On Disturbances of Sensation with especial reference to the Pain of Visceral Disease' (*Brain*, parts i. and ii., 1893).

Treatment.—The treatment of pain is so involved in its causation, that but little can here be said with advantage on this point. It may be said generally, that pain ought, if possible, to be relieved, for its continuance is exhausting and mischievous to the nervous system. Rest is, as a rule, the first essential. Local applications, in the form of simple poultices, sinapisms, and counter-irritant or anodyne liniments, constitute the most ready means of relieving pain in many cases. Food of a suitable kind will often be the best means of relieving pain; and where the condition of the stomach prevents its being swallowed, it is frequently desirable to inject sustenance and alcoholic stimulants by enemata into the bowel. Constipation of the bowels, when accompanied by pain, should never (except perhaps in the case of lead colic) be treated by purgatives: belladonna, accompanied by minute doses of opium, is the best treatment. The drugs which have the greatest influence as anodynes are, doubtless, opium, cocaine hydrochlorate, and chloroform; but belladonna, Indian hemp, and various synthetically prepared carbon compounds, are often used with advantage. They all require to be employed with caution. A habit of increasing the dose of opium (even when it is employed in the form of morphine with the hypodermic syringe) is soon acquired. It is undesirable to allow patients to inject themselves. It is well, in all cases, to begin with a small dose, say gr. $\frac{1}{10}$ of acetate or sulphate of morphine—a dose which is stimulant and not narcotic. It is the narcotic dose which apparently is followed by a sort of recoil, suggesting the need for a repetition of the dose, and in larger quantity. *See* Neuralgia.

T. Buzzard.

PAINTER'S COLIC.—SYNON.: *Colica Pictonum*; Lead Colic; Fr. *Colique des Peintres*; Ger. *Malerkolik*.—A form of intestinal colic, due to the presence of lead in the system; so called on account of the frequency of its occurrence amongst house-painters. *See* COLIC, INTESTINAL; and LEAD, Poisoning by.

PALATE, Diseases of.—The affections of the palate are mainly surgical, and therefore it is only necessary to offer some general remarks about them in this article, as those which are more strictly medical are sufficiently considered in other articles dealing with diseases involving the structures forming the mouth and throat, while paralysis of this part is dealt with separately. *See* PALATE, Paralysis of.

The palate consists of two parts—namely, the hard palate, and the soft palate with its arches. This structure takes an important share in the performance of deglutition, as well as in articulation. It is liable to be affected by any of the morbid conditions which are met with in the throat, and assists in the production of the symptoms resulting therefrom. If the palate is inflamed or ulcerated, marked soreness or pain is likely to be felt when anything passes over its surface in the act of swallowing. As a rule it can be very readily inspected, and its condition thus made out. The points that demand more special notice with reference to the palate are—that it is not uncommonly the seat of more or less extensive congenital deficiencies, as in the different forms of cleft palate; and that it may be destroyed in various degrees during the progress of ulceration, in some instances a perforation remaining, in others the whole soft palate being removed, or even the hard palate being involved in the destruction. Consequently the two functions above referred to are often seriously impaired. During the act of deglutition, substances tend to pass into the nasal cavities through the posterior nares, especially liquids; while speech is markedly nasal or guttural, and indistinct, or in some cases almost unintelligible, it being impossible for the patient to articulate the words properly. In some cases the features are at the same time more or less distorted.

TREATMENT.—This must as a rule be directed to the particular disease which affects the palate in common with other adjacent structures. Should it be congenitally deficient, or destroyed by disease, surgical operations are often of the greatest service; or plates or other appliances of different kinds may have to be worn.

FREDERICK T. ROBERTS.

PALATE, Paralysis of.—The chief causes of paralysis of the palate are diphtheria (*see* PARALYSIS, Diphtheritic); degeneration of the nuclei of the medulla oblongata (*see* LABIO-GLOSSO-LARYNGEAL PARALYSIS); growths in the basis cranii; and pressure on the nerves of the medulla. The first two causes usually lead to bilateral paralysis. Unilateral paralysis is commonly due to one of the last two causes. Disease of the trunk of the facial nerve is commonly regarded as an occasional cause of paralysis of the palate, but this is certainly an error; the chief nerve-supply to the palate is from the spinal accessory, as clinical observation and experiments alike have proved.

SYMPTOMS.—In *bilateral* paralysis the palate hangs flaccid, and irritation of the mucous membrane excites no reflex movements. It is not raised in breathing or phonation: a convenient test is to make the patient utter the sound 'ah' in a high tone; the central palate should be raised by the levator. Deglutition is interfered with, the soft palate being no longer raised so as to shut off the posterior nares; and liquids are forced up into the nose by the contraction of the pharyngeal muscles. Speech is also affected: the resonance of the nasal chambers gives to it the 'twang' which only the *n* and *ng* sounds should possess. The explosive consonants cannot be well pronounced, because the open passage through the nose prevents the air being sufficiently compressed to give the sudden sound when the passage between the lips is open. Hence *p* and *b* become *f* and *v* respectively.

Unilateral paralysis of the palate causes little interference with deglutition. The chief muscles which raise the palate meet, it will be remembered, in the middle line of the soft palate, and for this reason one muscle is able to effect sufficient elevation of the whole palate to prevent the regurgitation of liquids. The voice may have a slight nasal twang, but the articulation of the labial explosives is not interfered with. When at rest, the paralysed half is usually a little lower than the other. The uvula is said to be oblique, inclined towards the opposite side. It is, however, sometimes straight in the middle line. A change in form when the azygos contracts may be expected, but is not always to be observed. The chief indication of the paralysis is the unequal movement, which is best recognised during the utterance of the sound 'ah.' The elevation of the middle part being confined to one side, the base of the uvula is drawn a little towards the non-paralysed side, and a dimple forms above the base of the uvula on that side only. By faradisation a difference in the contractility of the muscles may be recognised, but the special apparatus and difficulties of application render this test not one of general usefulness. Unilateral paralysis of the palate is often associated with that of the vocal cord on the same side, and often with paralysis and wasting of the same side of the tongue. This combination is met with

especially when there is pressure on the nerves at the anterior part of the medulla. The paralysis of the tongue is, of course, due to disease of the roots of the hypoglossal; that of the vocal cord and palate to damage to the highest roots of the spinal accessory nerve.

Diagnosis.—The recognition of bilateral paralysis of the palate depends on its immobility on voluntary effort and reflex stimulation; that of unilateral paralysis on the inequality of movement in the utterance of certain sounds. Difficulty in diagnosis is due to the frequent inequality of the arches, and obliquity of the uvula. The latter is so common under normal conditions, that no weight can be attached to it as an indication of paralysis. The opinion that the palate is sometimes paralysed in facial paralysis rests apparently upon the uvula being found to be oblique, and observers have been strangely puzzled by the frequency with which the uvula deviates to, as well as from, the paralysed side, and have formed various ingenious theories to account for the relation; the deviation is, in reality, a 'natural abnormality,' and has no connexion with paralysis.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the palate are those of its causes. Locally the muscles may be galvanised by a long electrode, insulated except at its extremity, and furnished with a contact key, so that the circuit is not completed until the instrument is in position. The difficulty of applying electricity for any length of time lessens, however, its practical value as a means of treatment. Food that is semi-solid is usually swallowed better than liquids.

W. R. Gowers.

PALERMO, in Sicily.—Moist, warm, equable. No sudden atmospheric changes in winter; the mean temperature being 55° F. *See* Climate, Treatment of Disease by.

PALLIATIVE (*pallium*, a cover).—A term used in connexion with the treatment of disease, when it is directed merely to the relief or mitigation of symptoms. *See* Disease, Treatment of.

PALLOR (Lat.).—Synon.: Fr. *Pâleur*; Ger. *Blässe*.

This term, which signifies whiteness or absence of colour, is generally applied in descriptive medicine and pathology in connexion with the state of the blood-supply of any part or organ. Pallor then denotes extreme deficiency of that healthy colour of the tissues which is referable to the presence of the red corpuscles in the capillaries; and indicates anæmia, whether due to contraction of the blood-vessels, diminution in the quantity of blood generally, reduction in the number of red-corpuscles, or relative deficiency of hæmoglobin in the individual corpuscles. In clinical medicine, pallor is most frequently associated with the visible portions of the surface, especially the face, the lips, and the conjunctivæ; or with parts which may be readily seen by special methods of examination, such as the tongue, fauces, larynx, mucous membrane of the nose, and fundus of the eye. *See* Anæmia.

J. Mitchell Bruce.

PALPATION (*palpo*, I handle gently). A method of physical examination, in which the hands are employed to appreciate certain conditions perceptible by the sense of touch. *See* Physical Examination.

PALPITATION (*palpito*, I beat or throb).—*See* Heart, Palpitation of.

PALSY.—A popular synonym for motor paralysis. *See* Paralysis.

PALSY, SHAKING.—A synonym for paralysis agitans. *See* Paralysis Agitans.

PALUDAL, PALUSTRAL (*palus*, a marsh).—Of or belonging to a marsh. A term generally used in connexion with malarial or marsh fevers, on account of their frequent ætiological association with marshes. *See* Malaria.

PANCREAS, Diseases of. — Synon.: Fr. *Maladies du Pancréas*; Ger. *Krankheiten der Bauchspeicheldrüse*.

The pancreas is an organ of great importance in the animal economy, as it forms a secretion of essential value in the process of digestion, and probably has other functions. Nevertheless, owing to the comparative rarity of its diseases, their frequent association with other lesions when they do exist, the position and relations of the organ in the abdomen, and other causes, it must be acknowledged that there is no organ in the body which it is more difficult to recognise during life as the seat of disease, at least with anything like certainty. At the same time, it may be remarked that, if more attention were paid to the pancreas by the general body of medical practitioners, our knowledge concerning its morbid states would probably be increased, and we should have more definite and precise data upon which to form a diagnosis. Many seem to forget entirely that there is such an organ, and even when symptoms or signs point to it with sufficient clearness, at any rate as being the possible seat of mischief, they ignore it altogether, and it never seems to enter into their calculation. On the other hand, too much importance must not be attached to the pancreas, and it is especially necessary to guard against being led away by vague theories which attribute the origin of certain special diseases to functional disorders of this organ. During recent years more attention has been given to the morbid anatomy and histology of the pancreas,

as well as to its symptomatology, while it has been submitted to some remarkable investigations by experimental physiologists and pathologists. Hence our knowledge concerning this organ has made decided progress, and we may confidently anticipate even more definite results in the future.

PATHOLOGICAL RELATIONS AND SYMPTOMATOLOGY.—Before considering the diseases of the pancreas individually, it will be expedient to discuss generally the clinical phenomena which may arise when this organ is involved, and this will give the opportunity of referring to certain important pathological relations which it presents. The most striking of the symptoms are due, not only to the implication of the pancreas itself, but also to its effects upon other structures with which it is anatomically so closely related; to their being involved in the morbid condition; or to the intimate relation existing between its vessels and nerves, and those of other organs.

1. **Subjective Sensations.**—Subjective sensations cannot be said, as a rule, to be of much value in the diagnosis of pancreatic affections. They are often absent, even when there is grave disease; and when present are in many cases of a very indefinite character. As regards their site, the localisation of morbid sensations deep in the epigastrium, in the region of the pancreas, would be suggestive of this organ. With respect to their nature and causation, it may, in rare instances, happen that pain is felt in the pancreas itself; or there may be merely an ill-defined sense of uneasiness and discomfort, or of weight and oppression. Deep pressure may then bring out more pain or oppression, or these feelings may only be experienced when such pressure is made. More commonly, however, pancreatic disease gives rise to subjective sensations by its effects on surrounding structures. It may probably cause pain and a more superficial tenderness than usual, by irritating the overlying peritoneum. When the organ is enlarged and heavy, it may produce a sensation of stretching and dragging, amounting occasionally to actual pain, and possibly under these circumstances different postures might influence the sensation, which may be chiefly felt in the erect position. The most important pain, however, connected with pancreatic disease, is that due to implication of the solar plexus and its ganglia, of which the writer has met with striking examples. Sometimes acute inflammation occurs, when the pain is of a severe, and may be of a violent, character; or more commonly the nerves are merely irritated, and this is attended with paroxysms of severe pain shooting in various directions, which may amount to extreme agony. In either case there is a feeling of great oppression, restlessness, and anxiety, with a tendency to faintness, or actual syncope or collapse may take place. The suffering may be very obvious in the appearance of the patient. In one case, observed by the writer, the pain was greatly relieved by pressure. It might be supposed that a paroxysmal pain would be associated with the passage of pancreatic calculi, but of its occurrence there is no adequate proof. It might possibly happen that a continuous dull pain arises from erosion of the spine, as the result of pancreatic disease.

2. **Disorders of Secretion.**—Without entering into any discussion, it may be affirmed that the pancreatic secretion is now generally regarded as of most importance in 'duodenal digestion,' and that it acts upon proteid elements and albumoses, as well as upon starches and fats, the last-mentioned being chiefly emulsionised, and to a slight degree saponified (Allchin). Hence it might be anticipated that obvious and definite consequences would arise from any disorder of this secretion, whether affecting the quantity which is formed or which reaches the intestine, or the quality and composition of the fluid. Such consequences have been attributed to pancreatic functional disorder or organic disease, and these may now be briefly discussed.

To *hyper-secretion* of pancreatic juice has been attributed a variety of pyrosis, and also of diarrhœa, with the discharge of a slimy and viscid fluid, but the writer has never met with any case bearing out such an idea.

A *deficiency* or *absence* of pancreatic secretion from the intestinal canal, or an *abnormal quality* of this secretion, may be attended with phenomena of a more reliable character, although here again caution is needed. It is not unlikely that these disorders may assist in originating symptoms indicating deranged intestinal digestion, especially flatulence, and also diarrhœa or constipation; but for a discussion of this subject the reader is referred to the interesting *Bradshaw Lecture* for 1891 on 'Duodenal Indigestion,' by Dr. Allchin. More important and definite phenomena have, however, been referred to this cause, and these demand fuller consideration. One of the most striking is the presence of a quantity of free fat or oily matter in the stools, or of certain fatty compounds. This symptom has been regarded under certain circumstances as pathognomonic of pancreatic disease. It has been found in a considerable number of cases, and experimental investigations lend support to the importance of the phenomenon. On the other hand, it has been chiefly, though not exclusively, noticed where the entrance of bile into the intestine was at the same time interfered with, and sometimes when this condition alone was present, the pancreas being healthy; while it certainly is not always observed even in grave organic disease of the

pancreas, as the writer can testify. The amount of the fat has varied much in different cases, as also have its characters. It has come away like oil, with scarcely any fæcal matter; or, after standing, oil has floated on the surface of liquid fæces, or of water. In other instances the stools have been greasy, or lumps of fat have been discharged, white or pale yellow and tallow-like, and the evacuations have even consisted almost entirely of these lumps. In other cases, again, it has been more or less crystalline, consisting of compounds of fatty acids with sodium, calcium, or magnesium; or an oily fluid was discharged, which condensed on cooling, either around the containing vessel, or on the surface of the fæces. It has been observed occasionally that the fat was far greater in quantity than had been taken as food; this has been accounted for by the absorption of fat from the general system, in connexion with wasting, and its escape into the intestinal canal. Another condition of the stools attributed to want of pancreatic secretion is the presence of an abundance of undigested muscular tissue in them; but it is obvious that this can in no respect be regarded as a reliable sign. Possibly an excessive discharge of peptones in the stools may be due to this cause.

The significance of colourless or clay-coloured stools in relation to pancreatic disease is an important question which has been especially brought forward by Dr. T. J. Walker of Peterborough (*Med.-Chir. Trans.* vol. lxxii. p. 257). In two cases under his observation, copious loose stools were persistently passed, colourless, and of a peculiar putrid odour. There was no jaundice, and *post-mortem* examination revealed that the pancreatic duct was obstructed, while the bile-duct was quite pervious. Arguing from these cases, as well as from other data, Dr. Walker arrives at the following conclusions:—

First: That the formation of the colouring matter of the fæces (hydrobilirubin?) depends on the *mutual reaction of the bile and pancreatic fluid, under the influences met with in the intestinal tract.*

Secondly: That in disease a deficiency of pancreatic juice will, equally with a deficiency of bile, cause the pathological condition of colourless or clay-coloured stools—that is, stools destitute of hydrobilirubin.

Thirdly: Since that portion only of the coloured constituents of the bile which has been converted into hydrobilirubin is excreted in the fæces, while the bilirubin, bilifuscin, and biliverdin not so converted are absorbed, it follows that if hydrobilirubin cannot be produced without the aid of the pancreas, that organ must have an important *rôle* in regulating what proportion of the bile secreted by the liver shall be absorbed in the intestine, and what shall be thrown off in the fæces.

If these conclusions are correct, they have an important practical bearing in different directions. In the present connexion, however, they need only be noticed in relation to the diagnosis of pancreatic disease. Dr. Walker maintains that the passage of colourless stools as a permanent symptom, while every other indication of disordered liver is wanting, is evidence of such disease, and is a valuable aid in diagnosis.

It will not be out of place to refer here to the proved value of the pancreas itself, or of preparations made from it and containing the active principles of its secretion, in aiding digestion in many cases, or in digesting certain foods before administering them, especially according to the plan so admirably worked out by Sir William Roberts (*see* PEPTONISED FOOD). This may possibly help in the diagnosis of pancreatic disease, for it has been suggested that if, with the daily administration of calf's pancreas, the conditions of the stools above described disappear, additional evidence is afforded of the existence of such disease.

3. **Symptoms from Physical Effects.** The intimate relations of the pancreas to important structures in its vicinity give rise to some of the most striking objective symptoms associated with its diseases. Of these, one of the chief is permanent jaundice, which often becomes extreme, due to closure of the bile-duct. In the writer's opinion this symptom becomes under certain circumstances a most important evidence of pancreatic disease. The pylorus or duodenum is also very liable to be obstructed, thus leading to chronic vomiting, often obstinate, with signs of dilatation of the stomach; by pressure on the body of this organ pancreatic disease has been known gravely to disturb its functions, and even to obstruct its cavity; or it has ulcerated through its walls, and given rise to gastric perforation and hæmatemesis. The vessels in relation to the pancreas are also important, as being liable to be obstructed, and thus to give rise to symptoms. The veins are especially to be remembered, namely, the portal, superior and inferior mesenteric, and splenic, which may be pressed upon or closed by thrombosis. Hence may arise ascites, intestinal hæmorrhage, enlarged spleen, and other phenomena, although in the writer's experience they have been absent. The vena cava inferior or the aorta may also be more or less compressed, and in the latter case a pulsation or even a murmur may be transmitted through the pancreas, simulating an aneurysm; indeed, this lesion has been actually caused by the compression of the aorta by an enlarged pancreas; while, on the other hand, aneurysm may cause pancreatic cirrhosis by pressure. By the extension of pancreatic disease, other structures at a more or less remote distance may be interfered with;

thus, the ascending colon has been obstructed, and also the ureter, leading to hydronephrosis.

4. **General Symptoms.**—It is an indisputable fact that pancreatic disease is not uncommonly attended with marked general symptoms, in the direction of wasting, which may reach extreme emaciation, with proportionate debility, and anæmia. In experimental investigations upon animals, complete removal or destruction of the pancreas has been followed by rapid loss of flesh and great muscular weakness, in spite of their being well-fed. What the actual cause of these symptoms may be is a matter of doubt and discussion. They do not depend merely on the want of pancreatic juice, provided other secretions are in sufficient quantity, for both fats and proteids can be digested and absorbed without its aid, while deficiency of diastatic ferment can be made up for by free administration of saccharine foods, which, however, do not prevent the wasting. Dr. Vaughan Harley, in a paper on 'The Pathogenesis of Pancreatic Diabetes' (*Brit. Med. Journ.*, Aug. 27, 1892), attributes the symptoms to 'non-assimilation, consequent upon a form of auto-intoxication arising from the substances normally secreted by the pancreas being retained in the organism, and there forming leucomaïnes, whose toxic effects lead to tissue-waste and muscular weakness.' From a clinical point of view, it must not be forgotten that in cases of pancreatic disease attended with general symptoms there are usually other causes which assist in their production, such as absence of bile from the intestine as well as of pancreatic juice, the nature of the disease itself, interference with the passage of food through the pylorus or along the duodenum, the implication of other structures besides the pancreas, or the presence of severe pain, causing much constitutional disturbance. Patients suffering from grave pancreatic disease are often very low-spirited and despondent.

5. **Changes in the Urine.**—In exceptional cases of pancreatic disease it is affirmed that fat has appeared in the urine as well as in the stools, either in the form of oil-globules, or of a greasy substance, becoming like butter on cooling. This was supposed to be due to the absorption of fat in the process of wasting. Far more important is the fact that various morbid conditions of the pancreas have been found associated with glycosuria or actual diabetes. These conditions include acute abscess, hæmorrhagic pancreatitis, chronic cirrhotic changes, atrophy, fatty degeneration, obstruction of the pancreatic duct by calculi, cancer, and cystic disease. The results of experimental investigations on the relations between pancreatic disturbance and glycosuria are also highly important. The experiments of Von Mering and Minkowski, as well as those of Vaughan Harley and others, have revealed the following facts: Complete removal or destruction of the pancreas in dogs, cats, rabbits, and pigs, is followed by diabetes of a severe form. As soon as the animals recover from the immediate effects of the operation, they suffer from polyphagia, polydipsia, polyuria, and glycosuria, as well as an increased secretion of nitrogen in the urine. As already stated, they rapidly lose flesh, and suffer from great muscular feebleness. They often pass into a state of collapse or coma shortly before death. The urine at this time frequently contains acetone, diacetic acid, and β-oxybutyric acid. In some cases there are remissions in the severity of the glycosuria, and when the emaciation is very advanced, or complications (such as peritonitis) arise, the sugar may be entirely absent. In other cases it entirely disappears shortly before death. Partial extirpation of the pancreas is not followed by glycosuria, even when less than one-eighth of the entire gland is left. Nor does it occur after ligature of the pancreatic duct, or injection of this duct with irritants, at least until atrophy or cirrhosis of the gland occurs. These operations are followed by azoturia, polyuria, and wasting. Diabetes occurs after complete ligature of the blood and lymph vessels connected with the pancreas. These conclusions have been gathered mainly from the paper by Dr. Harley, already alluded to.

Notwithstanding the facts just stated, the connexion between pancreatic disease and diabetes mellitus or glycosuria is by no means universally acknowledged, and different views are held to explain the phenomena observed. The subject was discussed at the Royal Medico-Chirurgical Society in January 1892, on the occasion of a paper read by the late Dr. Tylden, who maintained that the glycosuria was the result of some lesion incidental to the operation for removal of the pancreas; and that there was no relation between diabetes mellitus and a cirrhotic pancreas. Implication of the solar and cœliac plexuses and semilunar ganglia is believed by some to account for the phenomena, and other hypotheses have been advanced. As to the immediate cause of glycosuria in relation to the pancreas, those who recognise this relation also entertain different views. Heyden suggests that there is an increased formation of sugar, due to an increased wasting of the tissue proteids. Lepine and Barral consider that pancreatic diabetes is due to a want of a glycolytic ferment, which, in the normal state, is continually being formed by the pancreas, and poured along with the lymph-stream into the general circulation, there to destroy the sugar. This is the view favoured by Dr. Harley.

6. **Physical Signs.**—It is only in very rare instances that physical examination can detect the pancreas in health, and most of its diseases do not alter the organ in such a manner as to render such examination of any value in diagnosis. Moreover, even more or less marked physical changes are often difficult of detection, owing to the situation of the pancreas, and to distension of the stomach, or pushing forward of the liver. It may be affirmed that palpation or manipulation is really the only reliable and practicable mode of examination in the investigation of pancreatic diseases, and it must be carried out when the stomach and transverse colon are empty, and the abdominal muscles thoroughly relaxed. In some cases help may be derived from placing the patient on his elbows and knees; and pressure should not merely be made deeply from before backwards, but with both hands laterally from the hypochondriac regions. It may be possible to detect a general enlargement of the pancreas, as a slightly movable swelling, lying across the abdomen in its usual position; but the important condition to be specially looked for is a tumour of the head of the organ, which is deeply situated, always of small dimensions, rounded, smooth or nodular, usually very firm or hard, and firmly fixed, as if it were rooted in the depths of the abdominal cavity. Even if such a condition were found, however, it would be difficult to associate it distinctly with the pancreas alone, but for all practical purposes it would be sufficient for diagnosis. A pancreatic cyst may occasionally be detected by physical examination. The possibility of an enlarged pancreas being the means of communicating a pulsation or murmur from the abdominal aorta has been previously alluded to.

Special Diseases.—Before proceeding to the study of the individual diseases of the pancreas, the reader must make himself acquainted with the foregoing general discussion, and apply the information there given, as it is impossible to attach a definite and precise clinical description to each disease. It is highly probable that there are *functional disorders* of this organ, but they cannot be made out by any positive data. The organic lesions usually recognised may be considered according to the following plan:—

1. **Acute Inflammation.—Acute Pancreatitis.**—This disease has come more under notice during the last few years, and several cases have been recorded, a number of which were brought together in 1880 by Dr. Fitz, in the New York *Medical Record*. It occurs under different forms, which may be termed respectively *simple*, *hæmorrhagic*, *suppurative*, and *gangrenous*.

Ætiology.—Acute pancreatitis has been attributed to injury over the epigastrium, to abuse of alcohol, and other causes. In a pamphlet recently published, Mr. E. F. Garden has advanced the view that so-called 'influenza' is really 'epidemic pancreatitis.' As regards the hæmorrhagic form, most of the cases have occurred in persons over thirty years of age; and many of the patients had suffered from previous attacks of indigestion, occasionally with severe pain and vomiting. As a secondary affection, acute pancreatitis has been met with in typhoid fever, suppuration having exceptionally taken place in the later stages of this disease; acute tuberculosis; pyæmia and septicæmia; and other febrile conditions. Suppurative inflammation occurs mostly in adults under forty years of age.

Anatomical Characters.—In the simpler and milder forms of acute pancreatitis, the organ becomes injected and hyperæmic, swollen, and abnormally firm; and after these changes it may probably return to its normal condition. Parenchymatous degeneration may be observed in connexion with febrile diseases, the gland becoming filled with granular material, of an albuminoid nature. *Hæmorrhagic* pancreatitis may be associated with previous changes, of the nature of fibrosis, degeneration of the gland-cells, or 'fat-necrosis.' In this variety the pancreas is enlarged, and the interstitial tissue is infiltrated with blood, sometimes with clots. In some cases the neighbouring structures are also hæmorrhagic, and the whole may form a firm mass of considerable size, occupying the upper and posterior portion of the abdominal cavity. The root of the mesentery, the mesocolon, and the omentum may also exhibit hæmorrhages. These structures, as well as the abdominal fat, sometimes present areas of 'fat-necrosis.' *Suppurative* pancreatitis is characterised either by diffuse suppuration, with the formation of small abscesses; or by one or more large purulent collections, the pancreas occasionally being converted into an irregular cyst, filled with creamy pus. An abscess may burst into the duodenum, or into the peritoneal cavity. *Gangrenous* pancreatitis may follow or be associated with the hæmorrhagic form. The organ may be converted into a dark, or slate-coloured, sloughy, fœtid mass; or it lies nearly free in the omental cavity, attached only by a few shreds of fibrous tissue; or it has actually separated, and been discharged through the bowel. Acute peritonitis is often present in the more severe forms of pancreatitis. The solar plexus is likely to be involved, and the semilunar ganglia may exhibit definite changes, being swollen, with the nerve-cells indistinct, and an interstitial infiltration of round cells (Osler).

Symptoms and Diagnosis.—It will be readily understood that acute pancreatitis may be unattended with any definite or characteristic symptoms. In its less severe

forms, deep-seated epigastric pain and tenderness, with gastric disturbance, and some degree of pyrexia, might lead to a suspicion of its presence. These symptoms may afterwards subside, or go on to more pronounced phenomena. The clinical description given by Mr. Garden of the supposed epidemic pancreatitis is that of influenza.

Acute hæmorrhagic pancreatitis sets in with a more or less sudden, violent, or even agonising pain, usually in the epigastrium, but sometimes more general over the abdomen. There is much tenderness, with muscular tension, preventing examination. Nausea and vomiting are usually prominent symptoms, with thirst, constipation as a rule, and frequently tympanites. Fever may or may not be present. Other phenomena which have been noted are great restlessness, prostration, hurried breathing, weak and rapid pulse, a tendency to syncope, and early delirium in some cases. The condition rapidly becomes more and more grave, signs of collapse supervene, and the termination is almost always fatal, death usually occurring from the second to the fourth day. A case of recovery is reported by Osler. The grave symptoms in this form of pancreatitis are attributed to the implication of the solar plexus and semilunar ganglia.

Suppurative inflammation of the pancreas has a very indefinite clinical history, and can rarely be recognised. It may start with epigastric pain, tenderness—which may be sharply limited to the site of the pancreas, vomiting, and sometimes prostration. There is irregular fever. Objective signs of abscess are very rare. Death may occur in three or four weeks; or the disease sometimes becomes chronic, with slight or occasional pyrexia. In *gangrenous* pancreatitis death generally occurs in from ten to twenty days, preceded by collapse; but recovery has taken place in exceptional instances, after discharge of the slough by the bowel. Glycosuria may be associated with acute pancreatitis. Distinct signs of peritonitis may supervene during its course.

With regard to *diagnosis*, obviously this must be always very difficult and uncertain. The chief conditions for which acute pancreatitis may be mistaken are acute affections associated with the stomach, liver, and gall-ducts; and, in the graver forms, intestinal obstruction, or certain varieties of perforation, especially that due to gastric ulcer or gall-stones, followed by peritonitis.

Treatment.—But little can be definitely said on this matter. The most obvious indications are to keep the patient at rest; to give only small quantities of liquid food; to relieve the pain and gastric symptoms by means of ice, effervescents, with hydrocyanic acid, opium, or morphine, and similar remedies; to open the bowels; and to give stimulants for the support of the patient, when these are called for. Ice, or, on the other hand, fomentations or poultices, might be applied with advantage over the epigastrium in different cases; and it has been recommended to put on a few leeches. Peritonitis must be treated on the usual principles, if it should be set up.

2. **Chronic Diseases.**—It will be most convenient to indicate, in the first place, the nature and origin of the several chronic diseases of the pancreas; and then to discuss as a whole their clinical characters and relations, and their treatment.

(*a*) *Changes affecting circulation.*—Under this head it will only be necessary to mention that, in cases of general anæmia, the pancreas suffers along with other organs; that in all conditions which impede the portal circulation, whether in connexion with the portal trunk, the liver, or the heart or lungs, this organ becomes the seat of mechanical venous congestion and its consequences; and amongst the latter hæmorrhage is to be noted, which occurs in separate points, the blood subsequently undergoing the usual changes, and its sites being indicated by altered pigment, or by spaces containing coloured serum and having pigmented walls.

(*b*) *Changes in growth.*—Many cases of either general or partial *hypertrophy* of the pancreas have been described; but it is very doubtful whether there is a true hypertrophy of the glandular elements, the increase in size and weight of the organ in these cases being probably due to an increase in the interstitial tissue. *Atrophy* is an undoubted morbid condition to which the pancreas is liable. It has been observed as the result of old age; in cases of general wasting from various causes; in connexion with diabetes, where it may become extreme; or from certain local causes, namely, pressure upon the gland-tissue by morbid conditions in its vicinity, or by diseases within the organ itself, or obstruction of its duct. The degree of wasting varies; but it may be so considerable that nothing is left except a fibrous cord indicating the former site of the pancreas. In lesser degrees the change is often associated with more or less fatty degeneration.

(*c*) *Chronic inflammation.* — *Chronic pancreatitis.—Cirrhosis of the pancreas.*—That the pancreas is subject to a chronic inflammatory process cannot be doubted, but it is by no means clear what should be included under this term. The condition usually recognised, and which is most common, is that in which the organ becomes more or less *cirrhotic* or *fibroid*, either throughout its whole extent, or in some portions of its substance: the head is very liable to be thus affected. The changes essentially consist in an increase of the interstitial connective tissue, with wasting of the glandular structures; and the organ becomes proportionately indurated, dense, firm, and tough, and may

be granular or irregular. Distinct tracts of connective tissue may be visible. Various degrees of the cirrhotic pancreas may result from prolonged venous congestion; chronic alcoholism, especially indulgence in strong spirits; retention of the pancreatic secretion, with dilatation of the ducts; the irritation of morbid growths, especially cancerous or syphilitic; or neighbouring disease, which affects the pancreas either by direct extension, or by causing pressure or irritation. In some of these cases a chronic parenchymatous inflammation seems also to be going on. Dr. Tylden recognised at least two forms of cirrhosis in the pancreas, as the result of microscopical examination—the one coarse and interlobular, often seen in very wasted pancreases, the other fine and intercellular in pancreases not necessarily wasted. The latter form he found chiefly in patients who were the subjects of chronic granular kidney, and he suggested that the pancreatic change might throw light upon some of the symptoms of this disease in some cases, such as polyuria and wasting.

Very rarely the pancreas becomes the seat of chronic *suppurative inflammation*, either by extension from parts around, or from conditions in the organ itself, such as the presence of calculi, or the formation of cysts. As a rule, however, this condition is the remnant of an acute purulent formation. The pus either infiltrates or collects in one or more abscesses, and the latter may burst into the abdominal cavity or other parts, or dry up and become calcareous. Caseous masses may form in the pancreas, associated with similar products elsewhere, in cases of scrofulous or tubercular disease.

(*d*) *Degenerations*.—The pancreas is liable to the usual two forms of fatty change, namely, a *fatty hypertrophy* or *infiltration*, associated with obesity, which, though affecting the interstitial tissue, may eventually cause complete wasting of the glandular structure by pressure; and *fatty degeneration*, which affects the gland-cells themselves; or the two conditions may be associated. In simple fatty degeneration the organ becomes gradually smaller, softened, and flaccid; pale or whitish-yellow or brownish; but its acini are distinct. A fatty emulsion may form in the ducts. The products of degeneration are absorbed or discharged, and coincident atrophy takes place, so that at last the organ may entirely disappear. This degeneration has been noticed as the result of alcoholism, in wasting diseases, and in cases of diabetes. The pancreas may become almost entirely converted into a mass of fat, after obstruction of its duct by a calculus. In the condition termed 'fat-necrosis,' previously alluded to in relation with acute pancreatitis, areas of dead-white, opaque, necrotic tissue are seen about the lobules of the organ.

Amyloid disease may affect the pancreas, but it cannot be said to be of any practical consequence.

(*e*) *Morbid growths*.—Cancer is one of the most important diseases affecting the pancreas. The growth is usually of the schirroid type, rarely of an encephaloid, a melanotic, or a colloid nature. In most cases it is secondary, the organ being usually involved by extension from neighbouring structures, or now and then a distinct growth being formed; but it also occurs as a primary affection, although very rarely. When primary, it appears usually to start in the epithelium of the pancreatic duct. Pancreatic cancer is decidedly more frequent in males than females; and it is rare under forty years of age. The writer has, however, known it to occur in a young man twenty-three years old. Primary cancer has been attributed to injury over the epigastrium. As a rule, the head is first implicated, rarely the body or tail; often the disease remains confined to the head, but in other instances it spreads, so as finally to involve the entire organ, or separate deposits form. When the morbid condition is confined to the head, it presents a more or less rounded tumour, varying in size, but never attaining large dimensions; somewhat irregular or nodular; usually very dense and hard in consistence; and whitish on section. If the entire gland be affected, similar appearances are evident throughout its whole extent; but if not, the unaffected portion may be the seat of atrophy, chronic inflammation, or dilatation of the ducts, with the formation of calculi. Distinct small tumours are found in some instances. Usually the growth exhibits under the microscope a large amount of fibrous stroma. Often the structure is that of a cylindroma or duct-cancer, but sometimes it is of the ordinary glandiform type (Fagge and Pye-Smith).

Pancreatic cancer always affects, in some way or other, neighbouring structures. It may simply press upon them; or it causes irritation, and thus sets up chronic inflammation, becoming adherent to various parts; or the cancer may spread; or destruction and ulceration take place, involving the duodenum, stomach, vessels, peritoneum, diaphragm, vertebræ, or other structures; but not uncommonly the parts are found so matted together at the *post-mortem* examination, that it is impossible to separate them, or to say where the disease began. Obstruction of the bile-duct, which is a frequent event in pancreatic cancer, seems to be due, not so much to pressure as to contraction at the orifice or along the course of the duct, the result of chronic inflammation.

As rare morbid growths found in the pancreas, it will suffice to mention lymphoma or lymphosarcoma; tubercle, though it has been affirmed by some that this is never found in the organ; and syphilitic formations, which may be of the nature of gummata, or of a

cicatricial tissue, involving the gland generally or locally.

(*f*) *Obstruction and dilatation of the duct.—Pancreatic cysts.*—The main duct of the pancreas—canal of Wirsung—may be obstructed at or near its orifice; or some of its divisions may be thus affected. The former depends either upon conditions outside the gland, causing pressure, or closing the opening, such as tumours in the vicinity, enlarged glands, a large gall-stone in the bile-duct, or thickening and adhesion due to inflammation; or upon conditions in the gland or duct itself, namely, malformations causing a bending of the duct, calculi, new-growths, cicatricial contraction, or possibly catarrh of the duct. One or other of these conditions also accounts for any localised obstruction. The obstruction will lead to retention of the secretion, with dilatation of the main duct and all its branches, either uniform or unequal, or of limited portions of these, according to the seat of the impediment; and ultimately one or several cysts usually become developed. In the early stage the contents resemble more or less the ordinary pancreatic secretion, but subsequently they become either serous, purulent, hæmorrhagic, caseous, or cretaceous. The walls of the cysts become thickened and indurated, and, by encroaching upon the substance of the pancreas, at the same time setting up a chronic interstitial inflammation, they may ultimately cause complete destruction of the organ. Sometimes it becomes converted into a mass of fat, as the result of the lodgment of a calculus in the main duct.

Pancreatic cysts demand more particular notice, as during the last few years several cases have been reported, in which a cyst of this nature has attained a large size, and has been diagnosed and treated with success. Attention was drawn to the subject by Professor Senn in 1886–87, and an interesting paper was read by Dr. Newton Pitt and Mr. Jacobson before the Royal Medical and Chirurgical Society in 1891, in connexion with a case under their observation (*Med.-Chir. Trans.*, vol. lxxiv.) As to the origin and causation of these large pancreatic cysts, there is often a definite history of local injury, such as a kick, which is supposed to produce some laceration and extravasation of blood. With the latter is mixed the constantly increasing fluid from a torn duct. This probably becomes irritating, and thus excites the formation of a capsule about it (Cathcart). Another theory is that the cysts originate in some digestive or corrosive action of the pancreatic juice upon the tissue of a previously diseased pancreas. A cystic pouch is thus formed, into which hæmorrhage easily takes place, either from a vessel in the wall of the cyst, or from one lying in an intra-cystic partition which has given way (Gussenbauer and Salzer). They have again been attributed to extension of inflammation along the pancreatic duct to the gland, leading to contraction of the duct-wall and accumulation of secretion.

A pancreatic cyst may attain considerable dimensions, and its walls may become more or less thick and firm. The fluid it contains is of sp. gr. 1010 to 1020; usually turbid, and greenish or brownish in colour, but occasionally clear and limpid, or opalescent and white; and alkaline. It contains from 1·5 to 3 per cent. of albumen, usually, if not always, mucin and a sugar-ferment, and in some cases tyrosin, blood-pigment, and a trace of urea. It is free from succinic acid, which may be present in hydatid fluid. It may emulsify fats; and often contains but a small amount of cell-products. Hæmorrhage is very likely to take place into a pancreatic cyst; and Senn has suggested that such a cyst may be due to parenchymatous hæmorrhage, followed by hæmorrhage from the cyst-wall; or to dilatation of one of the vessels of the pancreas. In rare instances a pancreatic cyst has been known to rupture into the stomach or duodenum.

(*g*) *Calculi and parasites.*—Calculi occasionally form in connexion with the pancreas, either in its main duct or, less frequently, in the branches, or in both situations. There may be but one, or a large number. They may be very minute, or attain the size of a nut or walnut, or even larger dimensions. The concretions are usually white or greyish-white, occasionally dark or blackish, round or oval in shape, rarely irregular or branched, and smooth or rough on the surface. As a rule, they consist mainly of calcic carbonate or phosphate, or of both salts; very rarely of solidified protein substances. They originate from the pancreatic juice, the inorganic constituents of which are precipitated, usually owing to its retention; but it is supposed that the products of catarrh of the ducts, or an abnormal composition of the secretion, may also be the primary cause of the precipitation which leads to the formation of pancreatic calculi. Their effects have been already pointed out in the description of the preceding diseases, and it will suffice to mention that the principal conditions they are liable to produce are dilatation of the ducts and the formation of cysts; inflammation leading to abscesses; chronic interstitial inflammation and its consequences; or inflammation in the structures around. They probably escape in some instances through the canal of Wirsung.

As regards parasites, it will be enough to state that round-worms occasionally find their way into the pancreatic duct.

Clinical History and Symptoms.—It will be easily understood that most of the cases of chronic disease of the pancreas are unattended with any symptoms drawing attention to this organ, or at least with such

as are at all characteristic; while a large number present no symptoms whatever, being latent from first to last, the lesion being only discovered at the *post-mortem* examination. Moreover, in the case of the affections which might be expected to originate prominent symptoms, they are so often associated with morbid conditions of one or more of the other organs concerned in the digestive process, or of other structures, that it frequently becomes most difficult or impossible to assign to each its actual share in the production of the phenomena observed. Under any circumstances, several of the chronic pancreatic diseases which have been described can only lead to more or less derangement affecting the formation or escape of the secretion, and all of them tend to produce this result, so that symptoms might be expected to arise from this cause; but those which are regarded as at all significant are only present in comparatively few instances, even of those pancreatic lesions which are of a grave nature.

In addition to what has just been stated, it will only be necessary further briefly to allude to certain points in the symptomatology of those pancreatic affections, in connexion with which more evident clinical phenomena might be anticipated; the explanation of the symptoms has already been sufficiently discussed.

Chronic cirrhosis of the pancreas may be attended with deep-seated epigastric pain and tenderness, constant or increased paroxysmally. It certainly tends to be complicated with symptoms associated with neighbouring structures, such as jaundice, ascites, or signs of obstruction of the pylorus or duodenum; and glycosuria or diabetes might possibly supervene. It very rarely happens that the enlarged pancreas, or its head, can be detected on physical examination. More or less general wasting may be present.

Cancer is clinically by far the most important disease of the pancreas, and the one most likely to give rise to symptoms of a definite character, though even here there is often much uncertainty. Deep-seated epigastric pain is a very frequent symptom at some period or other in the course of a case, and it has been rightly regarded as of much importance; but it must be remembered that it may be absent from first to last, or may only come on late in the progress of the disease. This pain, when present, is also characterised by its intensity, and the difficulty experienced in relieving it. It is usually more or less constant, and of an aching or gnawing character, or lancinating, shooting across the epigastrium, especially towards the right, or backwards towards the shoulder, or all over the abdomen. Sometimes a sensation of burning, or of tightness and dragging, is described. An important feature often observed in connexion with this pain is that it tends to become greatly aggravated in paroxysms, of which the writer has seen some striking examples, where the attacks were most agonising and almost unbearable. It may be influenced by food, coughing, deep breathing, movement, or posture. It is in some instances decidedly worse in the erect and supine postures; and during the paroxysms the patient may bend forward, and press upon the epigastrium, in order to obtain relief. Gastric symptoms are usually prominent in cases of pancreatic cancer, especially nausea and vomiting, and eructations; much importance has been attached by some writers to the occurrence of an abundant watery pyrosis. The tongue frequently continues clean and moist throughout. The bowels are constipated, and fatty stools may be observed; but they are by no means constant. Thirst is sometimes a marked symptom. Jaundice and other phenomena indicative of interference with neighbouring structures are of common occurrence, and persistent jaundice may be the most prominent symptom in cases of cancer of the pancreas. Physical examination is of essential importance in the detection of this disease, and it should be made again and again in doubtful cases, under the most favourable conditions obtainable. In many instances, however, nothing can be detected, at any rate of a definite character; or there may be only a sensation of undue firmness, resistance, or induration deep in the region of the pancreas. Sometimes the enlarged organ can be made out distinctly; or a tumour of the head, having the characters already described. The general symptoms are always of a serious character, namely, emaciation, anæmia, weakness, and depression of spirits, and they often become extreme. There may be distinct signs of the cancerous cachexia.

Calculi in connexion with the pancreas are almost always latent, but they may produce secondary effects causing symptoms. There is no authentic case of colic from the passage of a pancreatic calculus into the duodenum, so far as the writer is aware.

Pancreatic cysts.—When these are of small size they cannot be detected. A large pancreatic cyst may be recognised as a smooth, rounded or globular tumour, deep-seated, and retro-peritoneal, lying behind the stomach and transverse colon in the upper part of the abdomen, and tending towards the left side. It moves more or less with respiration, but is not movable by manipulation, and gives the impression of being attached to some deep structure. The tumour generally feels firm and tense, or elastic, but not distinctly fluctuating. It usually grows slowly, but may develop rapidly, and sometimes attains a very large size. Its relation to the stomach and colon may be made out more definitely by

distending these viscera with gas, or the colon with water. The symptoms which may be associated with pancreatic cyst are pain, more or less continuous, with paroxysmal exacerbations; jaundice sometimes, which may disappear when the cyst is aspirated, and return again as it fills; and wasting, which may amount to extreme emaciation. In doubtful cases the tumour may be aspirated, but this must be done with great care; and the fluid thus withdrawn, having the characters already described, is pathognomonic. The occurrence of hæmorrhage into a pancreatic cyst is accompanied with grave, and it may be rapidly fatal, symptoms.

Diagnosis.—Sufficient has been said in discussing the symptoms to indicate how difficult or impossible it must be to diagnose positively, in the great majority of cases, the existence of chronic disease of the pancreas. Cancer and large pancreatic cysts are the affections most likely to be recognised; and some of the others might be suspected under certain circumstances. What has been stated will suggest how they are to be distinguished from each other, but it would be very difficult to diagnose between a cirrhotic and a cancerous pancreas. With regard to the diagnosis of pancreatic lesions from those affecting some neighbouring structure, it must be remembered that these diseases are liable to be involved, and it may then be of little practical moment to determine precisely what structures are implicated. It is necessary to be particularly cautious against referring symptoms connected with the liver or stomach, induced by pancreatic disease, to a morbid condition of either of these organs; while it must always be borne in mind that enlargement of the liver may result from accumulation of bile, due to obstruction of the hepatic duct; and also that dilatation of the stomach will follow narrowing or closure of the pylorus or duodenum. It may be stated as a general rule that serious disease of the liver or stomach will probably reveal itself by obvious signs; and if this can be excluded in certain cases, the diagnosis of pancreatic disease will be appreciably aided. Of course these organs may be involved as well, or secondarily. The painful paroxysms connected with pancreatic cancer may readily be mistaken for the passage of gall-stones, should jaundice be present. If a solid tumour be felt, it may be difficult to distinguish a pancreatic from an omental growth. It must be remembered that an enlarged pancreas may present pulsation and bruit, conducted from the aorta, and thus simulate an aortic aneurysm. A large pancreatic cyst may now be fairly diagnosed by the phenomena already described. Dr. Pitt and Mr. Jacobson lay stress upon its relation to the stomach and transverse colon, in its diagnosis from tumour of other organs or of the main peritoneal cavity. It has been most commonly mistaken for an ovarian tumour. Certain mesenteric, retro-peritoneal, and occasionally other tumours may present some of the physical characters of pancreatic cysts, but aspiration will clear up any difficulty in diagnosis. In conclusion, the writer would insist once more, as bearing upon the diagnosis of pancreatic disease, on the importance of remembering that there is such an organ as the pancreas; and also of making a thorough physical examination, again and again if required, in any case in which disease of this organ is suspected.

Prognosis.—But little need be said under this head. Even if certain forms of pancreatic disease could be recognised, they may not affect life, but no positive opinion can be given. It has been affirmed that chronic pancreatitis is curable in the early stage, but of this there is no real proof; it probably aids in bringing about a fatal result sooner or later in those cases in which it exists. Pancreatic cancer is necessarily a fatal disease, and usually terminates in death within a year after the symptoms have become prominent. A pancreatic cyst has been cured by treatment in several cases.

Treatment.—The indications in the management of cases of chronic disease of the pancreas come within a very limited compass, even if it should be recognised. Rarely can there be any possibility of curative treatment being effectual, although supposed cures of chronic inflammation have been brought forward, obtained by the administration of calomel to act upon the pancreas, of saline purgatives, or of mineral waters of this class; or, when there has been a syphilitic history, by the use of mercury to produce its constitutional effects, or of iodide of potassium. In many cases the employment of saline aperients would be beneficial, to keep the intestinal canal free, and to unload the portal circulation. An occasional dose of calomel or blue pill might also be advantageous. In the large majority of cases of pancreatic disease the treatment would have to be chiefly symptomatic, directed especially to the relief of pain, to the symptoms connected with deranged digestion, and to the state of general wasting and debility. Hence, every case must be treated on its own merits, in accordance with well-understood principles. For the relief of the severe paroxysms of pain attending pancreatic cancer, subcutaneous injection of morphine is the most reliable remedy. The use of artificial digestants might be expected to be of much practical value in the treatment of cases of chronic pancreatic disease. Sweetbreads might be employed as an article of diet, or pancreatic emulsion or liquor pancreaticus might be given; but the previous digestion of the food by means of Benger's

liquor pancreaticus is the method likely to be followed by most benefit, and from this plan great advantage may be looked for in appropriate cases.

The treatment of a pancreatic cyst is entirely surgical, and abdominal section with drainage seems to be by far the best method. The cyst has also been removed completely, but this operation has generally proved fatal.

3. **Hæmorrhage.**—This lesion connected with the pancreas demands brief separate notice, but it is chiefly important from a medico-legal point of view. The event occurs suddenly, in a person who is in good health, and from no obvious cause. The symptoms are a severe pain in the upper part of the abdomen, which steadily increases, and is sharp or sometimes colicky; tenderness over this region; nausea and vomiting almost from the outset, which becomes frequent and obstinate, but gives no relief; tympanites sometimes; constipation generally; increasing anxiety, restlessness, and depression; and speedy collapse, with cold surface, cold sweats on the forehead, weak, rapid, and ultimately imperceptible pulse. The temperature is usually normal or subnormal. Death may occur almost suddenly or very speedily. The pancreas is found uniformly infiltrated with blood; and there may be extensive hæmorrhage into the mesentery, retro-peritoneum, or meso-colon.

FREDERICK T. ROBERTS.

PANDEMIC DISEASES (πᾶν, all; and δῆμος, the people).—Epidemic diseases which affect groups of several countries or the world generally. *See* EPIDEMIC; and PERIODICITY IN DISEASE.

PANTICOSA, in the Spanish Pyrenees. — Thermal waters. *See* MINERAL WATERS.

PAPILLOMA (*papilla*, a nipple, a wart).—A tumour composed of hypertrophied papillæ, either of the skin, or of a mucous or a serous membrane. *See* TUMOURS.

PAPULA (Lat.). — SYNON.: Pimple; Fr. *Papule*; Ger. *Papel.*

DEFINITION.—A minute prominence of the skin, for the most part conical, but often round, and sometimes flat; and resulting from inflammation or from accumulation of secretions.

A distinction must be drawn between inflammatory pimples and non-inflammatory pimples, the latter being simply over-distended follicles. In the classification of skin-diseases adopted by Willan the term *papulæ* represents a group of pimply affections; and he defines the word *papula* as follows: 'A very small and acuminated elevation with an inflamed base, very seldom containing a fluid or suppurating, and commonly terminating in scurf.' He thereby gives the word 'papule' a special signification. A typical physiological papula is presented to us in *cutis anserina*, where the pore of the skin or aperture of a follicle is projected outwards, in consequence of a certain rigidity, which opposes the contraction of the interporous tissue. The pathological papula is similarly located in the follicle of the skin, the prominence being produced by congestion of the vascular coat of the follicle, with more or less exudation into its capillary network.

ERASMUS WILSON.

PARACENTESIS (παρά, through; and κεντέω, I prick).—SYNON.: Tapping; Fr. *Paracentèse*; Ger. *Paracentese.*

DEFINITION.—The operation of tapping any cavity, to draw off fluid or gas.

The term is usually confined to operations on the peritoneum, pleura, pericardium, and cranial cavity; the tapping of cystic tumours not being included. Most of these operations are now performed with the aspirator (*see* ASPIRATOR). All those here described are performed with the cannula and trocar. The more extensive operations on the pleura, such as antiseptic opening, free drainage, trephining the ribs, &c., are described with the diseases which necessitate them. *See* PLEURA, Diseases of.

INSTRUMENTS AND OPERATION. — If the aspirator be not used, the best form of instrument for tapping the pleura or peritoneal cavity is that known as Thompson's syphon trocar. In this the cannula is fixed to the handle, and has a lateral opening about its middle, to which a long india-rubber tube is attached. The trocar is continued through the handle of the instrument and terminates in a button. In the handle the stem of the trocar is surrounded by air-tight packing. The instrument is inserted in the ordinary way, after being soaked for ten minutes in carbolic lotion (1 in 20); the trocar is then drawn back till its head is past the lateral opening in the cannula, through which the fluid will then flow. The india-rubber tube must be carried into a vessel containing carbolic acid solution (1 in 40). The result is that a syphon action is established, of sufficient force to exhaust the cavity operated on, and at the same time the accidental entrance of air is rendered impossible. Should the instrument described not be at hand, the following simple plan, suggested by Reybard, will be found very efficient. The cannula of an ordinary hydrocele trocar is surrounded by a linen petticoat, immediately below its external extremity, from two to three inches in length, which is well soaked in carbolic oil (1 to 10) before the instrument is used. On withdrawing the trocar the petticoat hangs down, forming a channel through which fluids readily pass outwards, but which collapses

instantaneously if there is any tendency to the entrance of air. This is especially useful in tapping the pleura. The same result can be obtained by applying a large veil of lint or rag, soaked in carbolic oil, over the cannula the moment the trocar is withdrawn. In tapping the cranial cavity or the pericardium very fine instruments, usually known as *exploring trocars*, must be used. In some cases, when the ribs are very close together, a flat cannula with a lancet-shaped trocar, may be useful. Before using a trocar it should be passed between the finger and thumb to feel if the free edge of the cannula is perfectly concealed by the wider head of the trocar. This is frequently not the case with old instruments, in which the cannula has lost the spring given to it by the two slits at the end. If the cannula project it may push the pleura before it, the head of the trocar only entering the cavity. A cannula and trocar should be always kept separate when not in use, to prevent rusting, and the head of the trocar should be well pushed into a soft cork. A blunt or rusty trocar doubles the suffering of the patient. Immediately before use the two parts of the instrument should be separately well washed with carbolic acid solution (1 in 20), or with some other powerful antiseptic. These precautions are of the utmost importance. A dirty instrument has often caused the death of the patient, by exciting decomposition in the cavity operated on; and real cleanliness can only be ensured by dipping the instrument immediately before use in some powerful antiseptic. A perfectly bright and apparently clean instrument may be in reality coated within and without with microscopic dirt, which antiseptics alone can render innocuous.

In using a trocar the instrument is held under the hand with the end of the handle in the hollow of the palm; the thumb is placed upon the rim of the shield of the cannula, ready to push it off without necessitating the employment of the other hand, and the forefinger is firmly pressed against the side of the cannula, at the point to which it is intended to limit the advance of the instrument. No preliminary incision is required if the instrument is in good order. It will only double the patient's pain, and increase the risk of non-union of the wound. It is advisable to draw the skin aside from its normal position before introducing the trocar, so that the superficial and deep parts of the puncture may not correspond when it is withdrawn. A valved opening is thus made, which can hardly fail to close readily.

Precautions.—When either of the large cavities is tapped, if a large quantity of fluid be rapidly removed, the patient is apt to become faint. These operations should, therefore, be always performed in the recumbent or semi-recumbent position, and stimulants should be at hand, the patient being carefully watched. Should faintness occur the operation must be immediately suspended. If the patient fears the pain of the puncture, the skin may be frozen, either by the ether-spray apparatus, or by the application of a piece of ice dipped in salt.

1. **Paracentesis Abdominis.**—This term is usually applied exclusively to the operation of tapping the peritoneal cavity for ascites, or, in very rare cases, for free gas. When the trocar is used for the relief of a distended bladder, or to empty an ovarian cyst or a hydatid of the liver, the simpler term 'tapping' is invariably used. The operation for ascites is performed in the following way: The patient must be made to empty the bladder immediately before the operation; if there is the remotest possibility that this cannot be done perfectly by natural means, a catheter must be passed. A strip of flannel wide enough to reach from the nipples to the pubes, and long enough to go two and a half times round the abdomen, must be in readiness. Each end is to be torn into four or five tails. The middle of the flannel is then to be applied to the front of the abdomen, and the tails so arranged as to interdigitate with each other opposite the spine. By pulling on the tails on each side a uniform elastic pressure is maintained over the abdomen during the operation, which facilitates the flow of the fluid, and diminishes the tendency to fainting. A circular hole is cut in the flannel at the point at which the puncture is to be made. The patient must be brought to the edge of the bed, and placed in the recumbent position, with the head low. If the quantity of fluid is not great, and the small intestines float up so as to come in contact with the lower part of the abdominal wall, it may be necessary to raise the patient into a semi-recumbent position, in which the intestines will float to the epigastric region. Having put the patient in position, the operator must himself percuss the abdomen between the pubes and the umbilicus immediately before inserting the trocar, and he will, of course, not proceed with the operation unless there is absolute dulness. Having ascertained that everything is in proper order, the skin is drawn a little to one side, and the trocar is plunged sharply through the abdominal walls in the linea alba, at a point midway between the umbilicus and pubes. Other points have been recommended, as the linea semilunaris, but the middle line is generally preferred. As soon as the trocar is withdrawn, the assistants pull firmly on the tails of the bandage, and continue to do so as long as any fluid flows. As soon as the fluid ceases to flow, the cannula is withdrawn, and a piece of lint, soaked in collodion, is applied over the puncture. The corresponding tails of the flannel bandage are then firmly tied together over the

middle line of the abdomen. For ordinary cases the aspirator is in every way inferior to the syphon trocar, and should never be used. If the patient should become faint during the operation the instrument must be withdrawn, the head put as low as possible, and some stimulant administered.

Dr. Reginald Southey has recommended a more gradual evacuation, in preference to the rapid method above described. He employs a very fine cannula, perforated laterally by numerous openings, and provided with a bulb-head and a shield. To the bulb-head is attached a long india-rubber tube. The cannula is inserted in the middle line, and fixed in position by strapping; and the fluid drains slowly away at the rate of about one pint per hour. The cannula may be allowed to remain in position, if necessary, for about twelve to twenty-four hours. Dr. Southey claims for his method the following advantages—simplicity; freedom from pain; absence of any tendency to syncope; and the avoidance of the necessity for bandaging afterwards. Experience has shown that there is no risk of peritonitis.

2. **Paracentesis Thoracis.** — SYNON.: Thoracocentesis.—This is required for serous fluid or pus in the pleura, and more rarely for blood or air. Aspiration should always be preferred to the operation by the cannula and trocar (*see* ASPIRATOR). Should the aspirator not be at hand, the syphon-trocar should be used; or, failing that, one of the plans before mentioned must be adopted to prevent the entrance of air during inspiration. The patient must be brought to the edge of the bed, and placed in a semi-recumbent position, well supported by pillows. The spot selected for puncture varies greatly. It is generally agreed that the trocar should never be introduced below the tenth rib on the left side and the ninth on the right, for fear of wounding the diaphragm. The point most commonly chosen is above the sixth or seventh rib, between the digitations of the serratus magnus, which can usually be clearly seen. Should they not be visible, any point may be taken in the proper intercostal space between the mid-axillary line and the junction of the posterior and middle thirds of the lateral aspect of the chest. The trocar must always be kept close to the upper border of the rib, in order to avoid the intercostal nerve and artery. In whatever space the operation may be performed, the lower border of the rib below the space should first be clearly felt: the skin is then to be drawn upwards for the width of the rib, and the trocar thrust sharply in immediately above its upper border. If the instruments are in good order, and the rib can be clearly defined, no preliminary incision is necessary. If, from partial absorption of the fluid, without corresponding expansion of the lung, the ribs have fallen very closely together, it may be necessary to use a flat trocar, with a lancet-shaped head. The precautions as to faintness and the closure of the wound are the same as in paracentesis abdominis.

3. **Paracentesis Pericardii.** — This operation is now invariably performed with the aspirator, as the results of the use of the ordinary trocar have been extremely unsatisfactory. *See* ASPIRATOR.

4. **Paracentesis Capitis.**—This operation has been occasionally performed in cases of chronic hydrocephalus, but without any very marked benefit. It is not safe to use the aspirator, as the vacuum might do unexpected damage to so soft a structure as the brain, while a small trocar may be passed through the expanded hemisphere into the ventricle without risk. The instrument used should be the smallest exploring trocar. An elastic bandage must be first applied, so as to exert a very gentle pressure on the head. The trocar is then introduced at any point where bone is deficient, except in the situations of the sinuses. The best place is at one side of the anterior fontanelle. The middle line must be avoided, not only because of the longitudinal sinus, but because in the vast majority of cases the fluid is contained in the ventricles. The quantity of fluid removed should not exceed two ounces. The elastic pressure must be maintained after the operation, which may be repeated at intervals of four or five days.

MARCUS BECK.

PÁRAD, in Hungary. — Sulphate of iron waters. *See* MINERAL WATERS.

PARÆSTHESIA (παρά, a prefix indicating irregularity; and αἴσθησις, sensation). A term applied to abnormal sensations experienced by a patient, distinct from mere excess or diminution of feeling; for example, tingling, itching, and formication. *See* SENSATION, Disorders of.

PARALYSIS (παρά, beside; and λύω, I loosen or relax).— SYNON.: Palsy; Paresis (incomplete paralysis); Fr. *Paralysie*; Ger. *Lähmung*.

DEFINITION.—Loss of the power of voluntarily exciting the contraction of one or more muscles, is the essential condition met with in all forms of motor paralysis. And, similarly, a loss of the possibility of transmitting impressions, either of the special senses or of common sensibility from various parts of the body, from their seats of peripheric commencement inwards to those portions of the brain which are concerned with their realisation in consciousness, is what is commonly known as 'sensory paralysis.' These latter defects are, however, considered under the head of SENSATION, Disorders of. Here attention will be confined to the subject of motor paralysis, to which, indeed, the term 'paralysis' ought to be limited. It is more

fitting to speak of loss of sensation than of paralysis of sensation.

Paralysis, Motor. — Motor paralysis may, in different cases, be occasioned by defects in various parts of the neuro-muscular apparatus. Certain primary differences of kind have first to be considered.

(*A*) Certain muscles may not contract because their customary neural incitations are impeded or abortive at their source in the cerebral cortex—as in certain forms of hysterical or functional paralysis, or as a result of definite lesions in some portions of the brain-region just mentioned.

(*B*) Other forms of paralysis result because voluntary motor incitations are impeded in transmission at some part of their course through the nerve-centres below the cortical stratum of grey matter in which they take origin. Under this head are to be included by far the larger number of cases of paralysis actually met with; and according as the situation varies in which the impediment to the transmission of motor stimuli exists, so do we get the paralysis occurring in different forms, that is, affecting different distinctive movements or groups of muscles, with or without certain characteristic associations, such as sensory paralysis or disturbance, alterations in the temperature of the skin over the parts affected, and, after a time, alterations in the nutrition of the muscles whose functions are in abeyance. These very numerous forms of paralysis fall into different classes, according as the disease or injury preventing the proper transmission of motor stimuli occurs (1) in some portions of their cerebral path; (2) in some portions of their spinal path; or (3) in their passage through some of the peripheral nerves, that is, in any part of their passage to the muscles outside the bulb or spinal cord.

(*C*) Lastly, though voluntary motor incitations may be normally generated, and properly transmitted through the nerve-centres and along the peripheral nerves, an incomplete paralysis of certain muscles may still result if such stimuli, owing to degenerative atrophy in the muscles, are incapable of evoking their contraction. In these, as in the other cases, the resulting loss of movement (akinesis) would represent a true paralysis. The fact that such forms of paralysis are often incomplete is dependent upon the peculiarity that some healthy muscular fibres usually remain in muscles which are the seat of atrophic changes (*see* PROGRESSIVE MUSCULAR ATROPHY). Modern research has demonstrated the existence of a group of diseases in which the changes in the muscles are primary. This occurs, for instance, in what is known as 'idiopathic muscular atrophy,' and also in 'pseudo-hypertrophic paralysis.' It must be said, however, that modern research has equally tended to show that in a very large majority of the cases of muscular atrophy such changes are sequential to previous lesions in the anterior cornua of the spinal cord or in the nerves. *See* PROGRESSIVE MUSCULAR DYSTROPHY.

The ÆTIOLOGY and PATHOLOGY of the diverse forms of paralysis will not now be further referred to, but will be discussed in various separate articles. Some general remarks on this subject will be found under the heads of NERVOUS SYSTEM, Diseases of; BRAIN, Diseases of; SPINAL CORD, Diseases of; and NEURITIS, MULTIPLE. Reference may also be made to the various special articles dealing with the pathological causes of brain-disease, and to the articles on the diseases of the different cranial and other motor nerves.

DIAGNOSIS.—The diagnosis or recognition of the cause or nature of any particular case of paralysis is always a many-sided problem. Having previously satisfied ourselves that it is a real and not a merely apparent case of paralysis (due perhaps to some arthritic disease), we have to endeavour to make out to which of the foregoing divisions or subdivisions the instance before us happens to belong. Paralysis of any group of muscles (in the limbs or elsewhere, and howsoever occasioned) may, of course, be either complete or incomplete; and it may be as well here to add that it is the incomplete forms of paralysis in the limbs (cases of '*paresis*' as they are often termed) which are most apt to be confounded with certain weaknesses or motor defects due to joint-disease.

In actual practice the *primary* question as to the nature of the paralysis may be, and commonly is, somewhat simplified, inasmuch as the varieties included under class *A* may be well merged in the first instance with the primary category of class *B* (that is, the cases of paralysis dependent upon defect in some portion of the cerebral path for outgoing motor incitations); just as those of class *C* may be included under the second and third categories of class *B* (that is, the cases in which there is defect in some portion either of the spinal or of the peripheral path for motor incitations). Thus the recognition of the varieties of paralysis included under classes *A* and *C* belong to the secondary or more special problems connected with diagnosis. The so-called 'hysterical' forms of paralysis, for instance, are to be regarded as due to functional perversion rather than to actual structural damage in certain portions of the nervous system. It seems evident, however, that in the first place we should decide whether we have to deal with a disease of the brain or of the spinal cord, before dealing with the secondary question as to whether such disease is of the merely functional or of the structural type.

Thus, for practical purposes the several

kinds of paralysis are primarily divisible into three distinct categories, based upon the situation of the damage, lesion, or defective activity by which they are occasioned. We have to do with—

1. *Paralyses of Encephalic Origin* ;
2. *Paralyses of Spinal Origin* ;
3. *Paralyses of Peripheric Origin* ;

according as the cause is one which operates upon or within some part of the great centres within the cranium ; upon or within some part of the spinal cord ; or upon or within some one or more of the nerve-trunks, in parts situated either inside or outside the cranium or the spinal canal.

It will easily be understood that each of these primary groups of paralysis, and especially the first, includes very many varieties, the recognition of which is often a matter of extreme difficulty—only to be achieved after an attentive and minute study of all the details of a case by those who are well instructed as to the anatomy and physiology of the nervous system, and most familiar by daily practice with the estimation of the import of the various signs and symptoms, in the light supplied by such knowledge.

The primary diagnosis should however, in the great majority of cases, be capable of being made by the practitioner with comparative certainty. In so doing he will be guided by the general agreement as to signs and symptoms presented by the case before him with one or other of the semi-combinations now to be mentioned.

1. **Paralyses of Encephalic Origin.**—These may or may not be ushered in by an apoplectic attack, by an epileptiform fit, or by a series of fits. The paralysis is usually confined to one half of the body, though only certain parts of it are affected, namely, more or less of one half of the face, with the arm and the leg (either incompletely or completely) on the same side, while the muscles of the trunk are comparatively little affected. Where the paralysis is incomplete, the arm is commonly more affected than the leg. Except where loss or impairment of consciousness still exists, or in cases where both sides of the brain are affected, the patient almost invariably retains control over the bladder and rectum. The common sensibility of the same half of the body may for a shorter or longer period from the commencement of the disease be more or less diminished. The electrical irritability of the paralysed muscles is not notably altered. The superficial reflexes are often diminished, and the deep reflexes mostly exalted on the paralysed side of the body. *See* SPINAL CORD, Diseases of.

These are the general characters of a form of paralysis due to unilateral lesions of the brain, commonly known as *Hemiplegia*. It is met with almost as frequently on the one as on the other side of the body, and may occasionally affect both sides simultaneously. A lesion in the right half of the brain produces hemiplegia on the left side of the body, and *vice versâ*.

2. **Paralyses of Spinal Origin.**—These forms of paralysis usually commence without convulsions or impairment of consciousness, though, like those of the last category, they may be either sudden or gradual in their mode of onset. They are, however, commonly characterised by the implication, to a variable extent, of both sides of the body. In the great majority of cases the lower extremities, either alone or with the trunk-muscles up to a certain level of nerve-supply, are the parts that are paralysed. The arms are much less frequently affected, because a large majority of lesions in the cord occur in its dorsal and lumbar segments. It is common for control over the bladder and rectum (one or both) to be more or less lost. The motor paralysis may exist with little or no impairment of sensibility; though in many cases sensation, in one or other of its modes, is defective in the paralysed parts. The upper limit of defective or altered sensibility is often marked round the trunk by a sense of constriction, or a feeling as if a band were tied round the body ('girdle sensation'). The electric irritability of the paralysed muscles may be either little altered, or it may, especially in some parts, be modified in the manner to be described in the next section as characteristic of the 'reaction of degeneration'—and in this latter case early and marked atrophy of such paralysed muscles may be looked for.

These are forms of paralysis commonly known by the name of *Paraplegia*. Both sides of the body are usually affected—equally or unequally—because of the frequency with which the lesion, or cause of the disease, involves both halves of the spinal cord. Where this is not the case, however, and the injury or lesion is confined to one half of the cord, in one or other region, a condition known as *Hemiparaplegia* results, in which, in addition to other special characters, there is an absence of any trace of facial paralysis, even though the arm and leg on one side of the body (where the lesion exists high up, in the cervical region of the cord) may be implicated in much the same manner as they are in hemiplegia. Here, however, the paralysis of motion occurs on the same side as the lesion.

3. **Paralyses of Peripheric Origin.**—The majority of paralyses resulting from disease or injury of motor nerve-trunks are rendered comparatively easy of recognition by the fact that the loss of power is in each case limited to the muscles supplied by particular nerves. This circumscribed nature of the paralysis is a fact of great value for diagnostic purposes—especially when the loss of

power is complete rather than partial, because it is in these cases more particularly that we are apt to get another characteristic sign of peripheral paralysis, namely, an altered electrical excitability of both nerve and muscles. Where the injury to or disease of a nerve-trunk is well-marked, so that its fibres are either severed or rendered incapable of conducting stimuli from the centres, owing to pressure or other causes, it is found that within a period of six to fourteen days the following electrical phenomena may be detected: Loss of irritability of the affected nerve-trunk to both electric currents; loss of or greatly diminished irritability of the affected muscles under stimulation by the faradic current, together with an increase of their sensitiveness to the voltaic or continuous current—so that they respond to the latter even more readily than the corresponding muscles of the opposite side. These characteristics, as a whole, together with certain minor peculiarities, constitute the so-called 'reaction of degeneration' (*see* ELECTRICITY IN MEDICINE). To these characters must be added the further peculiarity that the muscles thus affected are apt speedily (within two or three weeks from the onset of the paralysis) to show a marked amount of atrophy—a change easily to be appreciated in limb-muscles, and in some of those pertaining to the trunk, but by no means so obvious in the muscles of the face.

Morbid processes involving sensory nerves, special or other, are, of course, characterised by the nature of the special loss of sensibility, or by the area over which common sensibility is impaired or lost in different cases.

And, again, where we have to do with serious disease or damage to mixed motor and sensory nerves, this is detected by the recognition of motor and sensory defects so combined as to be compatible only with impairment of function in this or that mixed nerve.

The above constitute the characters which are in the main to be relied on for the diagnosis of paralyses of peripheric origin, caused by lesions of individual nerves. Still it must not be forgotten that when the ganglion-cells in the bulb or spinal cord, which constitute the nerve-nuclei of the several motor nerves, are diseased, we may have almost precisely the same effects produced as if the nerve-trunks had been damaged in some part of their course—that is, we may have in each case the electrical 'reaction of degeneration' followed by speedy atrophy of the affected muscles. In this case, indeed, where we have disease of an atrophic character limited to the nerve-cells composing the nucleus of a motor nerve or nerves, we should have a form of paralysis, tolerably well typified by 'labio-glosso-laryngeal paralysis,' which might almost with indifference be placed either in the category of spinal or of peripheric nervous disease. The lesion would be, it is true, spinal in seat; and yet it would be attended by all the clinical characters pertaining to disease of the nerve-trunks—and this naturally enough, seeing that the disease would in fact simply affect the proximal extremities of nerve-trunks.

What has just been said will serve to explain how it is that in many cases of paralysis of spinal origin, that is, due to large 'transverse' lesions, seriously damaging the grey matter of the cord, we may get, together with the wide or general distribution of such a paralysis, evidence that *in some* of the muscles the electrical 'reaction of degeneration' may be detected as well as early wasting. These characteristics of peripheral paralysis will, in fact, occur in muscles where the grey matter at the roots of the nerves, by which they are supplied, has been destroyed. In cases of paraplegia due to large transverse lesions limited to the cervical or to the upper dorsal region, we might, therefore, look for and find the 'reaction of degeneration,' with early wasting in some of the muscles of the upper extremities or of the trunk, whilst we should not find these characters, nor be warranted in looking for them, in the muscles of the equally paralysed lower extremities.

Of course, in most cases of paralysis, the patient's personal and family history, as well as the mode of onset of the disease, will help to throw light upon the question whether, in the case before us, we have to do with a paralysis of encephalic, of spinal, or of peripheric origin.

The further characters of paralyses of spinal origin (paraplegias aud hemiparaplegias) will be found described in the article SPINAL CORD, Diseases of; whilst those of the paralyses of peripheric origin will be found in the various articles on diseases of special motor and sensory nerves, such as the facial, the trigeminus, the sciatic, and many others.

The peripheral type of paralysis, wheu due to affections not of single nerve-trunks, such as we have hitherto been cousidering, but to the simultaneous affection of peripheral nerves in many parts of the body (mostly brought about by toxic agencics of differeut kinds), has, during recent years, been shown to be much more commou thau was previously suspected. This whole subject is, however, a very complicated one, which will be found treated mainly iu a separate article (*see* NEURITIS, MULTIPLE), as well as in others, to which references will there be given.

The type of those diseases included under the head of Paralyses of Eucephalic Origin will now be more particularly described.

This account of the characters pertaining to an ordinary form of **Hemiplegia** can perhaps best be given by detailing the combination of signs and symptoms produced by disease, either in the form of hæmorrhage or

of softening in or near the internal capsule as it passes through one of the corpora striata. We may suppose such disease to be situated on the right side of the brain, when, as a consequence, we should meet with a left hemiplegia.

Characters of Left Hemiplegia from disease affecting the internal capsule in or near the right Corpus Striatum.—Where there is a sudden onset of the disease and a large lesion, such as may occur especially in some instances of hæmorrhage, the symptoms may be ushered in by an apoplectic attack; and a condition of unconsciousness may remain, as a result of general brain-shock, for minutes, hours, or even days. Convulsions rarely occur in such a case. Where the hæmorrhage is slighter in amount, or where the causes of softening, in the form of vascular obstruction, are limited in seat and not abruptly brought about, there may be no loss of consciousness whatever at the onset, nor any sensation referred to the head. The patient may perhaps experience a mere momentary vertigo; and sensations of numbness or tingling rather than of actual pain may be felt for a minute or two in one or other limb, or perhaps in both limbs, before their weakness or actual paralysis is detected.

In a case of this kind, or after recovery of consciousness in the more severe form of the disease, the patient will on examination be found to present the following characteristics: (1) An absence of any decided mental disturbance; (2) slight 'thickness' of speech; (3) more or less deviation of the tongue towards the paralysed side, when it is protruded; (4) partial and incomplete paralysis of the facial muscles on the side on which the paralysis of the limbs exists—the angle of the mouth is lower and the naso-labial fold less distinct than on the opposite side, though the two eyes can be closed almost equally well; (5) more or less complete loss of voluntary power over the left arm and leg; (6) a flaccid state of the muscles of these limbs, which are found to respond naturally, or perhaps even a little too readily, both to the faradic and voltaic currents; (7) some slight loss of sensibility, as well as a feeling of numbness, on the paralysed half of the body; (8) slight elevation of temperature on the paralysed as compared with the non-paralysed side of the body—the difference being seldom more than one degree of the Fahrenheit scale.

Of these signs, the thickness of speech, the deviation of the tongue, the paralysis of the face, and the diminished sensibility, soon either grow perceptibly less or actually disappear. In the slighter cases, after some days or a week or two, there may also be some return of voluntary power over the leg and the arm; but in the more severe forms of complete hemiplegia, not proving fatal, any recovery of motor power in the limbs may be delayed for months instead of weeks, and then perhaps the recovery may be only very slight. In the majority of cases, however, the recovery of power begins to show itself in the leg sooner than in the arm; and the muscles about the proximal joints are in each case capable of being called into action before those moving joints which are more remote. Sometimes in the early stages of the disease some amount of rigidity may be met with in the arm or in the leg, or in both simultaneously, which is found to disappear during sleep—'early rigidity'; whilst later on a more permanent form of rigidity associated with organic changes in the muscles and tendons—'late rigidity'—is apt to supervene.

The particular combinations of symptoms met with in different cases of hemiplegia vary in an almost endless manner, as the situation of the brain-lesion varies, and also to a less marked extent in accordance with variations in its magnitude, and in the suddenness with which the lesion occurs. Thus, in regard to variations in the extent and completeness of motor paralysis alone, we may have merely a slight facial paralysis, with some weakness of the arm on the same side, and none of the leg; or the paralysis of arm and face may be more marked, together with slight paralysis of the leg; or paralysis may be pretty complete in all three situations. More rarely the leg may be more completely paralysed than the arm. At other times, from brain disease, paralysis may occur only in the face, in the arm, or in the leg; and then we have what is termed *facial monoplegia*, *brachial monoplegia*, or *crural monoplegia* respectively. But where lesions exist in both hemispheres of the brain, or in the pons Varolii, a double hemiplegic condition may exist—either complete or incomplete, and in the latter case probably unequal in degree on the two sides of the body. Similar variations exist in regard to many of the other concomitants of the hemiplegic state; for example, as regards the amount of mental disturbance, the kind and degree of impairment of speech, the amount of paralysis of tongue and difficulty of deglutition, the amount of paralysis of the face and of implication of the ocular muscles, the amount of impairment of common sensibility and of the special senses, the amount of difference in temperature between the two sides of the body, and the amount of command over the sphincters of the bladder and rectum. Combined in different groups, owing to the different relative development of these or those particular symptoms, we get the characteristics of all the different grades and kinds of hemiplegia actually met with in practice.

To attempt to connect this difference in grouping of the signs and symptoms with differences in the locality of the lesion, is to concern ourselves with the *secondary*, as

opposed to what has been previously termed the *primary*, problem of diagnosis. We should then have to consider what is more especially termed *regional diagnosis*, which, however, can only be attempted after careful study has been given to the several distinctive effects produced by disease in the different regions and parts of the encephalon, which will be found detailed in a series of special articles.

In attempting to arrive at a *pathological diagnosis* in any case of paralysis, our attention must be given more to the mode of onset of the affection, and to the state of other organs and parts of the body, than to the signs and symptoms of the established disease, though we are compelled to rely most upon these latter for the establishment of a regional diagnosis. Still these two sides to the problem of diagnosis are often very intimately related to one another, so that it may be essential to consider them concurrently in order to derive from each side of the problem all the light that may be possible for the elucidation or confirmation of the other half of it.

The questions concerning Prognosis and Treatment are considered separately under the head of the special forms of paralysis, and of the diseases giving rise to the different kinds of paralysis of encephalic, of spinal, and of peripheric origin.

H. Charlton Bastian.

PARALYSIS AGITANS.—Synon.: Shaking Palsy; Fr. *Paralysie Tremblante*; Ger. *Schüttellähmung*.

Definition.—A disease of advanced life; progressive in its course; and characterised mainly by tremors of the limbs occurring independently of muscular exertion, rigidity of muscles, and a tendency in walking to loss of equilibrium.

Ætiology.—The causes of paralysis agitans are obscure. It is rarely met with prior to forty years of age, but becomes more and more frequent as life advances. It affects both sexes, but men probably more frequently than women. There is little reason to regard it as hereditary. It has been attributed to violent emotion, to excessive bodily fatigue, and to exposure to cold and wet. It has also been referred to wounds or injuries involving nerves. In many cases no cause is assigned or can be discovered.

Anatomical Characters.—The disease, no doubt, is one of the nervous centres. But no distinctive lesion has yet been discovered in these parts. Sclerotic and other degenerative changes, evidences of sanguineous exudations in the course of some of the smaller vessels, diseased arteries, and various coarse lesions, have not infrequently been met with in the cord and brain; but the morbid changes hitherto observed have been variable in seat and character, and such only as are frequently present under other circumstances in persons who die in old age.

Symptoms.—Paralysis agitans, with few exceptions, comes on insidiously. The patient is first attacked with occasional tremors in a hand, a thumb, or a foot. These attacks come on irregularly, without obvious cause, and last for an uncertain period. But gradually they increase in frequency, duration, and severity, and spread from the part first involved, until, at length, probably all the limbs become implicated. In most cases the tremors, commencing in a hand or foot, by slow degrees invade the rest of the limb, and thence spread in hemiplegic fashion to the other limb of the same side. Less commonly the affection spreads in the first instance from one leg to the other. And very rarely do both arms suffer, the legs remaining free, or does the affection involve the limbs diagonally. Associated with the tremors, sometimes preceding them, but much more frequently coming on at a later period of the disease, there may always be observed a peculiar rigidity of the muscles. This is often attended with cramp-like pains, and, like the tremors, is liable at first to more or less obvious and prolonged intermissions. It implicates the muscles of the head and neck and trunk, as well as those of the extremities, and the flexor muscles in greater degree than their opponents. Another remarkable characteristic of the disease, always developed sooner or later, is an inability to maintain equilibrium when walking is attempted.

When paralysis agitans is fully developed, and the several phenomena above enumerated are associated, the collective symptoms produce a very remarkable and characteristic picture. The tremors involve the arms and legs; the head and neck remaining, as a rule, absolutely free. They consist of fine and rapid oscillations, which are more or less constant, but liable to exacerbations; cease during sleep; can occasionally be arrested temporarily by voluntary effort; and often occur with exceptional violence when the patient is otherwise at absolute rest. The movements of the hands are peculiar. The thumbs are usually extended, and the fingers flexed upon them; and collectively they move as though the patient were rolling a pencil or crumbling bread. The oscillations, however, are not limited to the hands, but involve the wrists and other joints of the upper extremities. The tremors of the lower limbs, especially when the patient stands, are necessarily transmitted to the rest of the body. In some cases the entire head, or the lower jaw, presents tremors like those affecting other parts of the body. The rigidity, which affects in a greater or less degree all the muscles, imparts a striking character to the patient's attitude and aspect. It causes the arms to stand out slightly from

the trunk; the elbow- and wrist-joints to be slightly flexed; the hands to be tilted towards the ulnar side, and to rest in front of the abdomen at or near the waist; and the fingers to be flexed or distorted at their several joints. It causes the trunk to incline forwards, as the patient stands or walks; the knees to be slightly bent; and the feet to be extended at the ankles; so that he rests upon his toes. But, above all, it causes the head and neck to be thrown forwards, and to be retained rigidly in that position, and the features to be immobile and inexpressive. This peculiar fixity of the head and neck and face, associated as it is with constant tremors in the limbs, constitutes a very striking feature of the disease. The difficulty of maintaining equilibrium, though no doubt increased largely by the presence of muscular tremors and rigidity, is not wholly due to them, for it may be well developed at a very early stage of the disease. Moreover, it may be long delayed. When thus affected the patient has some difficulty in rising from his seat; and, before he starts off walking, he probably hesitates a little, as though for the purpose of balancing himself. Then, with his body bent forwards, he begins to walk, perhaps with some care, but soon his steps become rapid and short, and he runs forwards in spite of himself, and if not arrested probably falls. Sometimes the tendency of the patient is to run backwards, even though the body incline forwards. Often in these cases, while the patient is being propelled forwards apparently in spite of himself, a sudden pluck at his clothes will reverse or alter the direction of his accelerating movement. These phenomena are not attended with vertigo.

Other symptoms less striking than the above, but of more or less importance, are usually present in shaking palsy. There is generally, even from the first, a great sense of weariness in the affected muscles, especially after exertion or an attack of tremors; but, contrary to what might be supposed, the tremulous and rigid muscles are, as a rule, markedly stronger than their as yet unaffected fellows. The patient, more particularly late in the disease, becomes excessively irritable and fidgety, so that at night especially he finds it difficult or impossible to place himself in a comfortable position; he is apt also to suffer from a painful sense of heat, mainly referred to the epigastrium and back. Speech generally becomes markedly affected, not from loss of language, but from difficulty of enunciation. Words are uttered slowly, and with manifest effort. Associated with this there is often tremulousness of the tongue. But the slowness and difficulty of utterance, which are often associated with slowness and difficulty of deglutition, constitute only one manifestation of the general slowness and difficulty of movement which, for the most part, characterise the disease. Sensation is not impaired; and the patient retains his mental faculties, as well as control over the rectum and bladder.

Diagnosis.—The affections with which paralysis agitans is most likely to be confounded are disseminated sclerosis, and mercurial tremors. But in the former of these the tremors occur only when the muscles are in use, and for the most part involve the head; the limbs early become paralysed; the patient has no tendency to run forwards or backwards; and generally nystagmus is present. In the latter affection there is probably a history of exposure to the fumes of mercury; the tremors involve not only the limbs, but the head and neck, and are symmetrical; and there is an absence of the peculiar gait of paralysis agitans. *See* Mercury, Diseases Arising from.

Progress and Terminations.—Paralysis agitans is of slow and often irregular progress, and usually lasts for many years; indeed it may be many years before it attains its full development. In rare cases it is recovered from in the early stage; but for the most part it is incurable. In its last stage the patient becomes confined to his couch or bed; the muscles waste; the tremors, though generally extreme at the time, occasionally cease; the mental powers fail; bed-sores form; and general prostration ensues. Death is due either to asthenia, or to some intercurrent disorder, more especially pneumonia.

Treatment.—In treating shaking palsy it is of importance to give careful attention to all hygienic measures, and to promote the patient's health, if need be, by tonics. Specific treatment has proved of little or no service. Nervine tonics and sedatives have been largely employed; and those which have found most favour probably are iron, strychnine, and hyoscyamus. The systematic use of baths has occasionally proved of temporary benefit. The persistent application of the continuous galvanic current seems to have been serviceable in some cases. Professor Charcot has recently recommended the use of the vibrating chair.

J. S. Bristowe.

PARALYSIS, Diphtheritic.—Synon.: Fr. *Paralysie Diphthéritique*; Ger. *Diphtheritische Lähmung*.—A peculiar form of motor paralysis, with a variable amount of sensory impairment, which develops in a subacute manner after diphtheria, increases and spreads, and either causes death or gradually passes away.

Ætiology.—The frequency with which diphtheria is followed by this paralysis varies in different epidemics from about 10 to 60 per cent.; on an average, about one-fourth of those who do not die from the primary disease suffer afterwards from definite palsy. It occurs at any age, but is rare in early

childhood, and seems to increase in frequency with age. Most cases occur in early life, because most cases of diphtheria occur then. Neither previous health nor severity of the primary disease influences its occurrence. It follows diphtheria of wounds as well as the common form. Paralysis, in various forms and degrees, occurs associated with, or as a sequel of, influenza, typhoid and typhus fevers, relapsing fever, cholera, dysentery, small-pox, and pneumonia; but only in rare instances does such paralysis bear a resemblance, never very close, to that after diphtheria. A similar paralysis has been supposed occasionally to follow tonsillitis, but it is probable that the antecedent sore-throat has been really unrecognised diphtheria.

Symptoms.—The onset is usually in the second, third, or, less commonly, the fourth week after the termination of the primary disease: but it may begin as early as the second day of convalescence, and, in rare cases, even while there is still false membrane in the throat. The first part to be *paralysed* is almost always the soft palate, the affection of which is revealed by the regurgitation, through the nose, of liquids that are being swallowed, and by a nasal tone in the voice, due to the resonance of the nasal cavities, which are not shut off as they should be by the elevation of the palate. The same defect prevents the compression of air in the mouth necessary for the articulation of the explosive consonants, and 'p' becomes 'm.' Soon afterwards, and sometimes first, the patient becomes unable to see near objects distinctly, on account of paralysis of the ciliary muscle. The limbs then become weak; the loss of power is irregular in its course and seat, but more or less symmetrical. It usually increases to a considerable degree of weakness, so that the patient may be unable to stand; but it does not amount to absolute paralysis. It is accompanied by flabbiness of the muscles, and often by distinct wasting in them, which is accompanied, in all but slight cases, by the change in electrical irritability in the nerves and muscles that shows an acute degeneration of the former. The muscles do not contract to faradism (which acts only on their nerves), but contract with undue readiness to voltaism (which acts on the muscular fibres themselves); and the order of response to the two poles, with different strengths of current, is often altered. Reflex action is lost in the affected limbs, including the kneo-jerk. The loss of this is indeed, in the majority of cases, one of the earliest symptoms; it may appear before the primary disease is over, and it is occasionally tho only indication of an affection of the nervous system. The paralysis, in many cases, is not confined to the palate, eye, and limbs: tho trunk-muscles may suffor, including the intercostals and the diaphragm; and the pharynx sometimes loses power, so that swallowing is very difficult. The movement of the vocal cords may be lessoned or lost: generally there is weakness of both adduction and abduction, so that the cords remain a little way apart; occasionally there is a preponderant loss of abduction, so that the cords are near together. Both cords are usually affected; in a few cases one only has been weak or motionless. The action of the heart may be rapid or retarded, apparently from an affection of its nerves. Very rarely the tongue, face, or eye-muscles have been weakened.

Sensory symptoms are also common. Loss of sensation in the limbs sometimes occurs early, and is greater than the motor weakness; more often it is subordinate to the latter in time and degree. It involves touch alone; or both touch and pain. It is greatest towards the extremity of the limbs, and generally symmetrical. It may be curiously limited in position, as to the palms and soles, or, when in very slight degree, to the fingers. The pharynx and upper part of the larynx also sometimes become insensitive, and the anæsthesia of the upper part of the latter may increase the danger of weakness of the pharynx, by facilitating the passage of particles of food to the glottis or into the bronchi.

The sensibility of the muscles is also often lessened, and there is frequently distinct *ataxy* or incoördination of movement, apparently in consequence of the deficiency of the afferent impulses from the muscles. Sometimes it exists in all the limbs, but is usually more marked in the legs than in the arms; and it resembles a moderate degree of locomotor ataxy. The resemblance is increased by the invariable absence of the knee-jerk, and the frequency with which there is impairment of sensation.

The *special senses* are seldom affected beyond the common loss of the power of accommodation in the eye. Restriction of the fields of vision has, however, been noted, and very rarely transient deafness. The *sphincters* have been affected in only a few very severe cases.

The *course* of diphtheritic paralysis is irregular and variable. Its onset is, indeed, almost uniformly by the affection of the palate and oye, although, in rare cases, one or both of these parts have escaped, or their impairment has been so slight as to be unnoticed. The order in which the other parts suffer, and the degree attained by the paralysis in each, present no uniformity. As it is passing away from one part, and the patient seems near convalescence, loss of powcr may commenco in some other part and may progress to a considerable degree: as the limbs aro recovering, the pharynx may becomo weak, or tho intercostals may fail to afford the needed strength

for breathing, or indications of paralysis of the heart may give reason for the utmost concern. When one part, however, has begun definitely to improve, the paralysis does not again increase in it, nor does it return to a part from which it has passed away. The duration of the affection is thus very variable, and may be from two weeks to three months. Death is usually due to weakness from inability to take food, in consequence of paralysis of the pharynx, to asphyxia from the weakness of the muscles of respiration, or to syncope from paralysis of the heart.

Pathology.—The naked-eye changes are confined to indications of congestion, and to minute hæmorrhages in the substance of the brain and spinal cord; very seldom larger extravasations have been found in the brain. The microscope, however, shows a varying degree of acute degeneration of the paralysed muscles, sometimes very intense and accompanied with increase of their nuclei. In a few instances, such intense changes in the muscles have been the only alteration found. On the other hand, the muscles have in some cases presented little change. Degeneration in the nerves is almost invariable. It is usually greatest towards the periphery, but in the smaller branches there may be disconnected tracts of degeneration. Occasionally it extends up to, and even involves, the anterior roots, very rarely the posterior roots. Its extent and degree correspond to those of the paralysis. The affection is one of the nerve-fibres themselves, the connective-tissue elements being little altered, except in the palatine nerves. First the medullary sheath breaks up, and afterwards, in a less extent, the axis-cylinder of the fibres. The spinal cord is often normal, but sometimes slight alterations are found in it, chiefly a granular change in the motor nerve-cells. In extremely acute cases, small extravasations have been found in the nerve-roots. Organisms have been often searched for, but as a rule in vain.

The similarity of these lesions to those met with in multiple neuritis due to toxic substances, simple and organic, together with the absence, in the neighbourhood of the affected structures, of the organisms which are the actual cause of diphtheria, makes it probable that the affection is the result of some chemical substance, circulating in the blood, and produced directly or indirectly by the organisms. This opinion is supported by the analogy presented by other diseases, in which changes in the nerve-elements are associated with specific organisms which have been proved to act indirectly through the production of a chemical poison. Moreover, the opinion has been recently shown to be correct by the investigations of Dr. Sidney Martin, who has found that the disease is associated with the presence of a peculiar 'albumose' in the blood; and that this, injected into the blood of an animal, produces both the symptoms, and the exact lesion in the nerves, of diphtheritic paralysis. He has ascertained facts which suggest that this poison is not produced directly by the organisms, but that these generate a ferment which enters the blood and acts on albuminous substances, especially in the spleen; and that these substances, under the influence of this ferment-like product of the organisms, are transformed into the poison. Apparently, the degree and extent to which the organisms give rise to these chemical processes vary in different cases; and possibly the result is influenced by differences, which we cannot yet otherwise discern, in the elements of the body from which the poison seems to be produced. But the facts ascertained afford a clear explanation of all the chief phenomena of diphtheritic paralysis.

Diagnosis.—Only when the character of the primary disease has not been detected is there any difficulty in recognising the nature of the paralysis; but its successive features are so special, that, even under these circumstances, the cases are few in which a difficulty ought to exist. It is greatest when the sore-throat has been so slight that medical advice was not sought, early paralysis of the palate was absent or unnoticed, and the affection of sight trifling and transient. But the subacute onset of the affection, the state of the muscles, and the distribution of the weakness, are sufficient to suggest strongly its cause. The absence of the knee-jerk is of especial significance, not only in the cases of motor paralysis, but also when sensory loss is the chief symptom, and its peculiar distribution puzzles the observer. The knee-jerk can be obtained only in some of the cases in which there are no symptoms in the legs. Its absence, in cases in which incoördination is the chief symptom, may, however, assist an occasional mistake, that of thinking that the symptoms indicate locomotor ataxy. It is sometimes thought that true tabes has developed, even if the nature of the primary disease was recognised, when the ataxy is of long duration. But it passes away even after several months.

Prognosis.—No case is free from danger to life, which may come on even in cases of slight degree or that seem to be progressing favourably, in consequence of the involvement of the muscles of respiration, of the pharynx, or the heart. Apart from these, the prognosis is good, although it is certain that in every severe case many months must pass before physical strength returns, and a still longer time before the constitution has regained its previous energy.

Treatment.—Extreme care to maintain the patient's strength, by careful feeding and by rest, is necessary in every case, however trifling it may seem, because we can never

feel sure that the strength may not be taxed to the utmost by some development of the disease. The difficulty of supplying nourishment is greatest when the need for it is most urgent — when the pharynx is so much weakened that swallowing is difficult or impossible, and dread of choking-attacks constitutes an additional difficulty. It may be necessary to give liquid food by a catheter passed through the nose, or by the rectum. In the latter case, especially, the process of digestion should be commenced, with pepsin or pancreatin, before the enemata are given. Great patience and tact are required in such cases in children to avoid the harmful influence of mental distress. The affected muscles may be gently rubbed, and voltaic electricity should be applied to them if there is conspicuous wasting, and especially if there is loss of faradic irritability. Apart from this loss, however, electricity is not necessary, and may do harm, in the case of children, by the emotional disturbance the application is apt to cause. Tonics, such as quinine, and iron if it is indicated by anæmia, may be given with apparent advantage, and it is possible that strychnine has some influence in promoting the recovery of the nerves. It is, however, doubtful whether it does good in the early stage of the affection, during which the only effectual agent would be one that neutralises the influence of the poison which is at work; and such an agent has yet to be discovered. Little can be done for other symptoms, and, indeed, for most of them little is needed. When the heart's action is unduly frequent and feeble, small doses of digitalis may be given, their effect being carefully watched. In sudden failure of the heart's action, faradisation to the skin of the præcordial region has been recommended; and in paroxysmal dyspnœa and imminent suffocation from the accumulation of mucus in the chest, from paralysis of the muscles of respiration, Duchenne believed that he had saved life by stimulating the respiratory centre by means of the application of faradism to the back of the chest.

W. R. Gowers.

PARALYSIS, INFANTILE. — Synon.: Acute Atrophic Spinal Paralysis; Anterior Poliomyelitis; Fr. *Paralysie Essentielle de l'Enfance* (Laborde); *Paralysie Atrophique Graisseuse de l'Enfance* (Duchenne); Ger. *Kinderlähmung*.

Definition. — Paralysis, acute in onset, various in distribution and extent, followed by recovery in some parts and persistence in others, with rapid muscular wasting and the electrical reaction of degeneration; commonly due to inflammation of the anterior grey matter of the spinal cord.

Ætiology.—This disease is most common in children at an age varying from a few months to a few years; three-fifths of the cases come on in the first three years of life, and hence the name by which it is often known; but it also occurs in older children and young adults, and is indeed met with at least up to middle life. In infancy, males and females suffer with equal frequency; subsequently, the affection occurs chiefly in males. Hereditary influences take but a trifling share in its causation. Season has a marked influence; three-quarters of the cases occur during the hottest third of the year. It often follows exposure to cold, and occasionally succeeds a fall at an interval of a few days. Over-exertion probably predisposes to it. It seldom follows any different malady; in the cases in which it has been thought to be secondary the general illness has really been part of the affection.

Anatomical Characters.—The atrophied muscles are found to have undergone granular or fatty degeneration, with disappearance, to a greater or less extent, of the transverse striæ. Many fibres, however, are simply narrower than normal, and occasionally a mysterious increase in width is found. Oil-globules and numerous fat-cells are also found between the fibres. Ultimately, in the most wasted muscles, fibrous tracts occupy the place of the muscular tissue, but among them a normal fibre, with its striation preserved, can here and there be seen.

It has been shown by the investigations of Cornil, Prévost and Vulpian, Charcot and Joffroy, of Lockhart Clarke and of others, that in fatal cases of infantile paralysis the spinal cord and its nerves are always affected. The few examinations made in the early stage have revealed a condition of acute inflammation of the anterior cornua, varying in degree at different parts, but extending only a short distance into the adjacent white substance. At an interval of years after the onset a condition is found such as acute inflammation would produce: shrinking of the anterior horns corresponding to the most affected muscles, with increase of the connective tissue in them, and disappearance of most of the motor nerve-cells, those that remain being reduced to small angular bodies. The corresponding fibres of the anterior roots are degenerated, and the degeneration can be followed down to the atrophied muscles.

Symptoms.—At the onset of the affection there are commonly symptoms of two classes: the paralysis already mentioned, and indications of general illness, apparently the result of a morbid blood-state—malaise, pyrexia, vomiting, headache, and sometimes general convulsions such as may attend any acute disorder in early life. These vary much in amount and duration; they may be severe, and last for days before the loss of power comes on, or they may be so slight as to be unnoticed. When severe, there is so much prostration that the process of the onset of the paralysis may not be noticed, and it may

only be discovered when returning strength reveals local disability. There is frequently pain in the limbs, and sometimes pain and tenderness in the nerves so pronounced as to justify the suspicion of a simultaneous disseminated neuritis; the latter, however, passes away, and the acute paralysis is always due to the lesion in the spinal cord. The paralysis, as a rule, is motor only. Sensation is impaired only in extremely rare cases in which inflammation is so intense as temporarily to affect all the conducting functions of the cord. When sensation is impaired there is always incontinence of urine; bed-sores are almost unknown, even in the acute stage of the disease. A slight local elevation of temperature in the most paralysed parts has been noted in the early stage, but subsequently the affected limb is colder than the other. This is due, at least in part, to the loss of the aid to circulation which, in health, is supplied by muscular action.

Reflex action is necessarily lost in the parts related to the muscles involved. That from the skin is at first abolished where there is weakness, but it returns with or soon after recovery of power in the less affected parts. If the paralysis is persistent it remains absent. The myotatic irritability is lost in the same or even greater degree, so that, for example, no knee-jerk is obtainable if the extensors of the knee are even slightly affected. This loss is due to the interruption of the muscle reflex arc by the disease of the grey matter. In rare cases of cervical poliomyelitis the morbid process may spread into the lateral columns, so that, in addition to the wasting and paralysis of the arms, there may be paralysis without wasting in the legs. In such cases the myotatic irritability in the legs may be increased. After a few months, however, the condition of the legs becomes normal.

When the paralysis of a limb is incomplete, the muscles involved vary in different cases; and as different parts of two or more limbs may be affected, the combinations of palsy which result are extremely varied. Sometimes the muscles affected are those which are functionally associated; more frequently the affection is random; but the commonest condition is an irregular affection of the muscles that are associated in the centre. The degree of affection of the individual muscles also varies, the loss of power in some being absolute, in others only partial. In the legs the paralysis is rarely complete; most frequently it is partial, and the muscles below the knee suffer more often than those above the knee. The calf-muscles are affected less frequently than the anterior tibial or peroneal muscles, and hence talipes equinus is a common form of the deformity that ensues from the contraction of the less affected muscles.

In the arm nearly all the muscles may be involved, but all are seldom entirely paralysed. The intrinsic muscles of the hand often suffer, and either the thenar muscles or the interossei may be most damaged. The muscles of the forearm are frequently affected, but the supinators may escape when the extensors are involved. Of all the arm-muscles, the deltoid is that most frequently affected; it may suffer alone or in association with others. The 'upper-arm type' of palsy, of Erb, is sometimes met with, in which the deltoid, supra- and infra-spinatus, biceps, and supinators, are all involved; but the irregularity of grouping is shown by the fact that the triceps is often affected with these muscles. The serratus magnus is occasionally affected, and the upper part of the pectoralis major (which is normally associated in function with it) may also suffer, while the lower part escapes. The middle part of the trapezius, and other of the scapular muscles, are occasionally involved. The cervical muscles rarely suffer, but the diaphragm is sometimes paralysed; permanent wasting of the intercostals and trunk muscles is rare, although they may be involved at first, and this should be borne in mind, as curvature of the spine has been produced by allowing the patient to sit up while the muscles were still weak. The muscles supplied by cranial nerves are rarely affected; the writer has once seen paralysis of the face on one side, associated with wasting of the limbs, in an otherwise characteristic case, and an instance of the affection of the face and tongue has been recorded by Dr. W. Pasteur.

Course.—The course of the disease has been already indicated. There are: (1) the initial stage of paralysis, lasting for a few hours, a week, or even a month; (2) a stationary period, which lasts for a week to a month; (3) a stage of 'regression,' during which the palsy passes away, except from certain parts in which wasting occurs; this period usually occupies from one to six months; and (4) a chronic stage, during which the atrophy continues, slight improvement may occur, but contractures and deformities are developed. These are due to distortion of the articulations in consequence of the contraction and permanent shortening of the muscles that are less affected than their opponents, which become fixed by tissue-changes in them, and by secondary changes in the ligaments of the articulations. It is especially at the foot that these occur, constituting some form of talipes, especially talipes equinus or equinovarus, less commonly talipes calcaneus. In the case of children, the growth of the most affected limb will be hindered, and in the case of the leg this may render the effect of the paralysis more obtrusive by its interference with the gait.

The duration of this stage is indefinite, because, wherever muscular tissue remains and some voluntary power returns, this

slowly improves, and the muscles develop under the influence of use, it may be during years. Complete recovery, in even the very slightest cases, is extremely rare, and, on the other hand, death from the disease is equally uncommon. If it does occur, it is in the early stage, and it may result from the initial disturbance before the nature of the complaint is recognised. Occasionally death takes place at the end of the first week or ten days, from universal paralysis, or from some profound associated cerebral disturbance.

Relapses are uncommon, and second attacks are practically unknown. Sequelæ are also rare, although in a few cases some other chronic affection of the spinal cord has come on when the subjects of infantile paralysis have reached adult life. Thus progressive muscular atrophy has been observed to start from a paralysed limb. Similarly, lateral sclerosis and acute and subacute anterior poliomyelitis have occurred in adults, the subjects of old infantile paralysis.

Diagnosis.—A difficulty in diagnosis is only likely to occur in the early stage, when the vomiting, which is so common, is apt to lead to the opinion that the affection is only gastric disturbance; and the pyrexia may cause the case to be regarded as a general febrile affection. The mistake can only be prevented by attention to the state of the limbs, and by giving due weight to any sign of defective power. Later, the wasting, the state of the electrical reactions in the muscles, and the loss of reflex action without any sensory change, will usually be sufficient to allow a definite diagnosis to be made. In the earlier condition, the existence of the paralysis is not unlikely to be overlooked, and the immobility to be ascribed to prostration. But total immobility, and still less local immobility, is not produced by prostration. When the pyrexia ceases, while the loss of power persists or increases, the existence of paralysis is always unmistakable. In adults the danger of a mistake in the early stage is less.

From chronic diseases of the spinal cord the condition is distinguished by its acute onset. Acute transverse myelitis may be closely simulated if the inflammation of the grey matter is bilateral; the age of the patient usually suggests correctly the nature of the disease. The usual form of transverse myelitis also occurs, as a rule, not in one of the enlargements, but in the dorsal region. Difficulty will, indeed, usually be prevented by the recollection of the fact that transverse myelitis in children is always poliomyelitis. The very slow onset of pseudo-hypertrophic paralysis, developing as it does gradually with the child's growth, should sufficiently distinguish it from this disease. Diphtheritic paralysis sometimes offers a difficulty, especially if the preceding sore-throat have been slight or unnoticed, but is distinguished by its gradual onset and special features. The distinction from cerebral palsy is usually easy; in this there is never loss of faradic irritability or of reflex action, nor is there extreme or local muscular wasting. The character of the convulsions also is different; those which take place at the onset of infantile paralysis are general, those which are associated with a cerebral palsy are usually unilateral or commence locally.

The only diseases outside the nervous system which may be mistaken for infantile paralysis are those in which movement is associated with pain, such as hip-joint disease, necrosis of the femur, or the affection known as scorbutic rickets, in which there are symptoms of scurvy associated with those of rickets. A careful examination is usually sufficient to show that pain is all that prevents movement. The preservation of the knee-jerk is often of great significance.

Prognosis.—In the vast majority of cases the disease involves no immediate danger to life. It is probably greatest when there is severe constitutional disturbance, and in consequence of this, before the characteristic paralytic symptoms have been noticed. There is also some danger from after-effects, especially in consequence of the slight power of resistance to other morbid influences which remains after the severe constitutional disturbance connected with the onset.

If the paralysis has remained stationary, that is, has not increased in extent, for twenty-four hours, the danger of further extension is small. As regards the question, What is likely to be the permanent condition?—an answer cannot be given for a week or ten days, and its nature will depend upon the condition found to be present on electrical examination. The muscles which then have lost faradic irritability will certainly waste, will remain for a long time paralysed, and will probably be to some extent permanently disabled. If, however, there is no loss of faradic irritability at the end of this period, but it is apparent at the end of a fortnight or three weeks, the wasting will be slighter in degree, and some ultimate recovery may be expected even in the most affected part. When there is no loss of faradic irritability, the paralysis will pass away in the course of a few weeks or, at most, a few months. But this condition is unfortunately rare.

In the chronic stage, unless there is some sign of returning power within three weeks, very little recovery will occur. The retention of voltaic irritability in the muscles is so far satisfactory as showing that there has been no destructive degeneration in them, and that there are favourable conditions for the exertion of voluntary power. But it does not lessen the grave significance of the existing palsy and the loss of faradic irritability, indicating persistent nerve-degeneration. If, on the other hand, at the end of

two or three months, some, however slight, faradic irritability can be detected, improvement is probable, and it may be considerable. It is always necessary to remember that in children an apparently increased disability, referable to arrest of growth, is really compatible with actual improvement.

Treatment.—The treatment in the early stage should be that of the general state, guided by any causal indications that may be detected, such as free sweating and salicylate of sodium in a case distinctly due to exposure to cold. If there is pyrexia, a diuretic may be added. The child should be kept at perfect rest on the side, and warmth applied over the affected part of the cord by poultices or fomentations. When there is spinal pain, marked relief is afforded by these means.

It is very difficult, in such a disease as this, to ascertain the effect of treatment, as there is a natural tendency for the morbid process to cease and for improvement to take place. Full doses of ergot and belladonna have been credited with the power of arresting it, although there is no definite proof that the arrest and the use of these remedies have been anything more than coincident. Either, however, may be employed apparently without fear of harm.

When the acute first stage is over, careful management must be continued for some time, especially in the cases in which the constitutional disturbance has been great. When the acute stage is over, tonics, especially iron and quinine, are needed. Strychnine also may be given in all cases, but it should not be commenced sooner than three or four weeks after the disease has become stationary. As the malady frequently occurs at an age at which rickety conditions develop from any interference with the general health, treatment with the view of anticipating such constitutional effects should be adopted in young children. For this purpose iron and cod-liver oil are especially useful.

The use of electricity is an important part of the treatment, and, in order to prevent its ineffective or harmful employment in unsuitable circumstances, the reasons for its employment ought to be clearly understood. There is no evidence that it can or does influence the process of recovery of the damaged elements either in the cord or nerves. The reasons for its use depend upon the fact that the disease entails nerve-degeneration, and that the related muscular fibres undergo changes in nutrition and ultimately perish if no nerve-regeneration occurs. While the influence normally exerted through the nerves is in abeyance, the muscles are destitute of functional stimulation, and it is with the view of supplying the place of this that electricity is to be used. When both cell and fibre have perished, electricity can do no good; but where there has been damage but not destruction, so that the fibres recover and again become capable of conveying nutritional and volitional influences, electricity is of distinct service in preventing a disproportionate failure of muscular nutrition. Only voltaic electricity can stimulate the muscle when the nerve-fibres are degenerated, and this is consequently the form that must be used. The mode of application is determined by the fact that it is only when the current is interrupted that the muscular tissue is stimulated to contract. One terminal is kept still, the other being stroked down the muscles and lifted from the skin at each stroke. Some place the immobile terminal over the spine, but there is no evidence that the spinal cord is reached in this way. The negative pole will be that most generally useful in stroking the muscles, as the normally greater irritability to the negative pole frequently persists. Of course, soft well-moistened terminals must be used, the skin also being thoroughly softened with water or salt and water, and a current should be used sufficiently strong to produce visible contraction, provided this does not cause distressing pain; if it does, it is better to be content with the strongest current that can be borne without emotional disturbance. The strength used should always be gradually increased.

Systematic rubbing of the affected muscles is also useful. This stimulates the circulation, which is always defective, and probably promotes nutrition. The muscles should be rubbed and gently kneaded daily, upward rubbing being especially useful. Great care should be exercised in keeping the affected limbs as warm as possible; and bronchial catarrh should be guarded against, especially in cases in which the respiratory muscles are involved.

The prevention of deformities of the spine or in connexion with contractures causing displacement at joints must be carefully looked to. Mechanical appliances may have to be ultimately adopted, and not infrequently tenotomy is necessary. But such deformities should as far as possible be prevented by systematic movement and attention to posture. The process of slow improvement, once started, may go on for years by the slow growth of the muscle that has recovered under the stimulus of use, and this improvement may be augmented by various contrivances for allowing the muscle to act to the best advantage.

W. R. Gowers.

PARALYSIS, SENSORY.—*See* Sensation, Disorders of.

PARALYSIS, TOXIC.—Various kinds of paralysis, due to multiple neuritis in the main, are produced by such poisons as alcohol, arsenic, and lead on the one hand; and by the poisons associated with certain specific diseases on the other, such as diphtheria,

tuberculosis, variola, and others of the exanthemata. Most of these conditions are described together under the head of 'multiple neuritis' (*see* NEURITIS, MULTIPLE; and PARALYSIS, DIPHTHERITIC). It should be remembered, however, that in the case of arsenic, and still more of lead, paralytic symptoms traceable to poisoning by these substances may be due in some instances, wholly or in part, to degenerative changes in the anterior cornua of the spinal cord. It has been thoroughly established that, in some cases, poisoning by lead leads to pathological conditions of the spinal cord very similar to those met with in chronic spinal paralysis. A similar tendency to involvement of the spinal cord, rather than the peripheral nerves, occurs during or just after some of the acute specific fevers. It is well known that the beginnings of various diseases of the spinal cord are prone to date from such a period.

H. CHARLTON BASTIAN.

PARAMENIA (παρά, irregularly; and μήν, a month).—A term for irregular menses. *See* MENSES OR MENSTRUATION, Disorders of.

PARAMYOCLONUS MULTIPLEX (παρά, indicating on both sides; μῦς, μυός, muscle; and κλόνος, commotion).—DEFINITION.—An affection, occurring in adults, usually ending in recovery, which is characterised by clonic spasm in the muscles of the limbs, symmetrical, but varying in different parts, and often more or less paroxysmal. It was first well described by Friedreich, who proposed for it this designation. Among the cases which have been since observed, there have been many variations from the type of the original case, and the malady is not well defined.

ÆTIOLOGY.—Little is known of the causes of the affection, beyond the general facts that it occurs chiefly in men, and may begin at any age between puberty and sixty years. It does not appear to be hereditary; cases of clonic spasm in several members of a family have differed considerably from this form. The onset has generally seemed spontaneous; in a few cases it has followed some apparent exciting cause, such as fright, rheumatism, or malarial fever, but such cases have been too rare to suggest more than a general disturbing influence on the nervous system.

SYMPTOMS.—There are sudden spasmodic contractions of the muscles, the same muscles on the two sides usually acting together, but in unequal degree. The contractions on each side involve a single muscle or only part of a muscle, or one or two adjacent muscles, and quickly pass from one part to another. Their frequency has varied from ten to fifty per minute; but they are irregular in time, a series of quick contractions being followed by longer intervals. In some cases tonic spasm has occurred from time to time, but it was not present in the case described by Friedreich. On the other hand, very slight, and even fibrillary, contractions have also been occasionally noticed. The spasm is seated chiefly in the larger muscles, especially the deltoid, biceps, triceps, extensors of the knee, flexors of the knee, and the calf muscles. It is in these muscles that the contractions are sufficiently strong to cause movement; slighter contractions are sometimes observed in the small muscles of the hands and feet. The diaphragm is occasionally involved, causing a peculiar sound, something like hiccough. Voluntary movement lessens the spasm, and occasionally arrests it; it is also diminished by alcohol and by mental excitement. In a few cases the contractions have continued during sleep. They have been so violent in some cases (which are at least allied to this form) that the energetic spasm has thrown the patient from the chair on which he was sitting. As a rule, there have been no other symptoms, in either the nervous or general system. After lasting for several months, or even for a year, the spasmodic contractions have gradually lessened, and, in most cases, have passed away.

Nothing is known of the pathology of the affection. Such clonic spasm characterises the 'electrical chorea,' which occurs in Italy, and is probably the result of a toxic influence, possibly malarial. But this is a fatal disease, and is thus sharply differentiated from 'paramyoclonus.' The latter is probably allied to the peculiar chronic 'senile chorea,' which is occasionally met with in persons who have not yet reached old age, and is sometimes recovered from.

TREATMENT.—It is not clear that any treatment has modified the course of the malady, which has had a definite tendency, in most cases, either to lessen or to persist. But it has been thought that benefit has been afforded by giving bromide of potassium as a sedative, together with quinine, strychnine, and other nervine tonics. Voltaic electricity has been said to do good in a few instances, a current as strong as the patient can bear being passed from the spine to the affected muscles for a quarter of an hour each day. In very severe cases the hypodermic injection of morphine has been useful. It is probable that phenazone or acetanilide would be beneficial, but the malady is so rare that therapeutical facts can only be very slowly accumulated.

W. R. GOWERS.

PARAMYOTONE (Paramyotonia; παρά, on both sides; μῦς, μυός, muscle; τόνος, stretching).—This name is applied to a condition characterised by muscular spasm. It is thus applicable to Thomsen's disease, a more

common designation of this condition being, however, *myotonia*. Two varieties of paramyotone have been described—the *congenital* by Eulenburg, and the *ataxic* by Dr. Gowers. In the former, several members of the same family were affected, and in some of these the symptoms were present soon after birth. The malady was characterised by transitory tonic spasm, easily excited by cold, and usually dispelled by warmth. The facial muscles were especially liable, and the rigidity was succeeded by weakness. There was no change in the electrical reactions, except that the irritability seemed to be lowered. In the solitary case of *ataxic* paramyotone, described by Dr. Gowers, there was persistent tonic spasm associated with ataxy. There was weakness both of arms and legs, but the incoördination was greatest in the arms. There was also impaired sensibility, distinct for touch and pain, slight for temperature, on the hands and feet, especially the palms and soles. No sign of myotatic irritability could be elicited, but the rigidity was such as to account by itself for this absence. There was no change in the electrical irritability of the muscles. JAMES TAYLOR.

PARAPHIMOSIS (παρά, beside; and φιμόω, I confine).—SYNON.: Fr. and Ger. *Paraphimosis*.—A morbid condition of the penis, in which the prepuce, having been drawn or forced back behind the glans, cannot be returned, and thus gives rise to a condition of strangulation of the parts in front of it. *See* PENIS, Diseases of.

PARAPLEGIA (παρά, incompletely; and πλήσσω, I strike).—Paralysis of the lower extremities, usually associated with paralysis of the lower part of the trunk, bladder, and rectum. *See* PARALYSIS; and SPINAL CORD, Diseases of.

PARAPLEGIA, ATAXIC.—The name 'ataxic paraplegia' has been given to a condition in which a lateral and a posterior sclerosis of the spinal cord co-exist. There does seem to be a tendency in some cases for sclerosis to occur simultaneously in these two columns, and thus to constitute a separate morbid entity. On the other hand, such a combination with analogous symptoms may present itself in disseminated sclerosis of spinal origin; as an extension of a primary lateral, or even of a primary posterior sclerosis; whilst something very similar may present itself also in Friedreich's disease (or 'hereditary ataxic paraplegia,' as it is also termed). Looking to the transition forms between these affections, it seems questionable whether any adequate advantage from a clinical point of view can result from the description of a separate morbid condition under the head of 'ataxic paraplegia.' It may be sufficient for us to recognise that, under the various conditions above referred to, we are liable to get a grouping of symptoms indicative of co-existing disease in the lateral and in the posterior columns. *See* SPINAL CORD, Special Diseases of.

H. CHARLTON BASTIAN.

PARAPLEGIA, INTERMITTENT. *See* NEURITIS, MULTIPLE.

PARASITES (παρά, upon; and σιτέω, I feed).—SYNON.: Fr. *Parasites*; Ger. *Parasit.*

DEFINITION.—This term, in its most extended sense, is applied to those organisms which derive their nourishment wholly or in part from other living beings. Parasites may be vegetable or animal—*phyto-parasites* or *zoo-parasites*; may live upon the surface of, or in the textures or cavities of, the individuals they infest—*ecto-parasites* or *ento-parasites*; and may pass through the whole cycle of their existence in the parasitic state, or only during certain stages of their life.

This definition will include such varied species as tinea and trichina, the various hæmatozoa, and many micro-organisms, which feed upon the living tissues of the hosts they infest; those which subsist on the material prepared by the host for its own nourishment, such as the intestinal worms; and, lastly, those which only temporarily sojourn on the surface of the body, for the purpose of obtaining food, and do not live, for any definite period of their existence, upon or within their entertainer—for example, fleas and gnats.

The majority of these parasites are direct causes of disease, although many may develop to a very considerable extent without giving rise to any symptoms of illness; and a few may be even regarded as normal inhabitants of the body, taking a share in healthy physiological processes, such as duodenal digestion.

A few only of the fungi, such as the blue moulds (*penicillium glaucum*), may be looked upon as a result of a morbid condition, being occasionally met with on the surface of old ulcers, and in old cavities of the lungs.

Parasites, Vegetable.—Vegetable parasites are included under the general term of *fungi*. More accurately they are to be provisionally referred to the three lowest classes of the sub-kingdom Thallophyta—viz.:

i. *Schizomycetes*, or Fission Fungi, which include Micrococcus, Bacterium, Bacillus, Vibrio, and Spirillum.

ii. *Saccharomycetes*, or Yeast Fungi, such as Torula, Mycoderma, and Oïdium albicans.

iii. *Hyphomycetes*, or Moulds, as Mucor, Aspergillus, Penicillium; also the various forms of Tinea, and Achorion Schœnleinii. *See* MICRO-ORGANISMS; TORULA; TINEA; and EPIPHYTIC SKIN-DISEASES.

W. H. ALLCHIN.

PARENCHYMATOUS (παρά, beside; and ἐγχέω, I pour in).—The word *parenchyma* was formerly used to designate the connective tissue of the several viscera; but it is now applied to the protoplasm, or active elements, of a tissue or organ; and morbid processes affecting the actual substance of an organ are hence called *parenchymatous*.

PARESIS (παρίημι, I relax).—A slight or imperfect paralysis of motion. *See* PARALYSIS.

PARONYCHIA (παρά, beside; and ὄνυξ, the nail).—Inflammation in close proximity to a nail. A synonym for whitlow. *See* NAILS, Diseases of; and WHITLOW.

PAROTID GLANDS, Diseases of. *See* MUMPS; and SALIVARY GLANDS, Diseases of.

PAROXYSM (παρά, indicating increase; and ὀξύνω, I sharpen).—This word is used to indicate the periodic attacks or fits which characterise certain diseases, whether regular or irregular, such as ague, gout, and asthma. It is also used to designate the aggravation of certain symptoms from time to time, such as neuralgic pain, colic, and dyspnœa. Diseases characterised by these phenomena are called *paroxysmal diseases*.

PARTIAL (*pars*, a part).—When applied to disease, this term may refer either to its extent, or its degree. Thus we speak of *partial paralysis*; and *partial blindness*, *deafness*, &c.

PASO ROBLES HOT SPRINGS, San Luis Obispo County, California, U.S.A.—Muriated saline sulphur springs. *See* MINERAL WATERS.

PASSIVE.—This epithet is used by some pathologists in connexion with certain morbid conditions, such as congestion, dropsy, œdema, and hæmorrhage, where there is deficiency of vital power, either general or local, and a want of reaction or resistance in the tissues. Some pathologists employ the term *passive congestion* as synonymous with congestion from obstruction (*see* CIRCULATION, Disorders of; and HYPOSTASIS). *Passive movements* of any part, for instance, of a joint, are movements effected by some agency external to the limb, such as the hands of the practitioner or of the patient himself, in contradistinction to movements produced by the muscles of the affected parts, which are called *active movements*. *See* MASSAGE.

PATENT FORAMEN OVALE or SEPTUM.—*See* HEART, Malformations of.

PATHOGENIC (πάθος, disease; and γεννάω, I give rise to).—A term applied to the production of a disease, having reference to the mode in which the several causes which lead to it operate in its development.

PATHOGNOMONIC (πάθος, disease; and γιγνώσκω, I recognise).—This word is associated with those symptoms and signs which are specially characteristic of a disease, and the presence of which renders its diagnosis certain. *See* DISEASE, Diagnosis of.

PATHOLOGY (πάθος, disease; and λόγος, a discourse).—Pathology is the name generally accepted for the science of disease, but the subjects which it may include cannot be exactly defined. For ease and disease, well and ill, and all their synonyms, are relative terms of which none can be defined unconditionally. If there could be a fixed standard of health, all deviations from it might be called diseases; but a chief characteristic of living bodies is, not fixity, but variation by self-adjustment to a wide range of varying circumstances, and among such self-adjustments it is not practicable to mark a line separating those which may reasonably be called healthy from those which may as reasonably be called disease.

The impossibility of marking such a line may be tested during changes in any external conditions of life; for instance, in the adjustments of the skin to a widely varying range of external temperatures. Where and when in the changes of skin produced by long contact with water rising from 20° F. to 200° F. would health cease and disease begin? Similarly in the consequences of mechanical injuries. The complete repair and reproduction of injured and lost parts is an excellent instance of health; and in many plants injuries elicit a greater production of healthy structures than would occur in their integrity—as in the leaf of a begonia or a cardamine, in which a fresh shoot may grow from each of many wounds. But while these and similar adjustments to conditions produced by injury may be deemed results and signs of health, many others, such as those which may follow severe crushings and open wounds of limbs, must rather be called processes of disease, even though they may end in some repair of injury. Among all the cases intermediate between these extreme groups of adjustment to consequences of injuries, it is not possible to separate the healthy and the diseased.

In this impossibility of scientific definition the range of pathology is vaguely settled by a general understanding as to what may be called disease, and in this settlement are included all the states which are distant from health, whether they be in the way of diverging from it or in that of returning to it, as in convalescence. And some states are in-

cluded for which it is hard to assign a better or other reason than that they are not useful to us. When fruits or other parts of plants or animals, which have been made useful by cultivation, revert to their more natural state and become useless to us, they are generally regarded as diseased.

Moreover, in the study of any disease its processes are found, though different, yet not essentially distinct or separable from those of health. Even in the instances of the widest deviations from health, as in the diseases called specific or malignant, a considerable part of the phenomena are due to processes tending towards a reversion to health, and even the changes most averse from health are limited within certain methods not wholly unlike the healthy ones.

In this view pathology may be regarded as an extension of physiology into the study of living bodies in conditions widely unlike those of their ordinary life. Pathology, herein, accepts the conventional limitation of physiology to the study of the nature of living things; but the limitation is convenient more than just. It is not possible to give a verbal definition of the difference between the study of crystals deformed or repairing after injury, and that of monstrosities and the processes of repair in plants and animals. As physiology is not truly limitable from chemistry and physics, so in pathology many processes are illustrated by things abnormal or contrary to general rule in dead matter.

Pathology finds in physiology its basis, the varying standards of healthy structure and function with which its subject-matters are in contrast, and the models and methods of its study; but its range is wider than that of physiology, inasmuch as the conditions giving rise to disease are much more numerous and more various than those of health. Moreover, the deviations from health may reach so far and wide, that the facts and general principles of physiology can only with extreme caution be applied to them. For instance, the greater part of what may be called personal characteristics in respect of health can only be observed in phenomena of disease. It is from observation of these that our knowledge is derived of diatheses or constitutional peculiarities, and of conditions predisposing to overt disease. Of them and their various minglings and alterations by inheritance, and by tendencies to reversion towards health, physiology can give no account; its suggestions cannot be safely used unless completely subject to the test of pathological inquiry.

It seems certain that many erroneous and too narrow systems of pathology have been derived from the beliefs of pathologists that they could safely, from the general truths of physiology or even from some section of them, infer what must be true in respect of disease. Hence, by means of inferences from the parts of physiology for the time being most studied, there have arisen the systems of *vital* and *chemical*, of *humoral* and *neural*, pathology, all containing many truths, but none of them able to stand the test, without which nothing in pathology should be deemed true—the test of a wide and direct study of diseases. It would be well if all systems of pathology which can be thus specially named should be suspected of great error. The science of disease should not be divided or specialised on any other ground than physiology may be, as by the names of *general*, *comparative*, *animal*, *vegetable*, and the like. The study of any one of these divisions, wide as it may be, is not safe unless with frequent reference to the others for their aid; and every study of diseases of one part or of one kind is very unsafe, unless with a constant consciousness of its narrowness and partiality. Even if it could be made sure that many diseases begin in morbid states of the blood or nervous system, or any other chief constituent of the body, it would be nearly as sure that within a few hours, or even minutes, of their beginning the other chief constituents would be involved. For the relations of the several parts are so intimate and, through the nervous system and the circulating blood, their means of communication are so swift, that if one be diseased none can long remain healthy. There is no truth more necessary to be held in pathology, and in its practical applications, than that the health of each part is a necessary condition of the health of all the rest. JAMES PAGET.

PAU, in the Basses Pyrénées, France.—A mild, calm, sedative, winter climate. Mean temperature, 42° F. Absence of cold winds; soil, gravel. *See* CLIMATE, Treatment of Disease by.

PECTORILOQUY (*pectore*, from the chest; and *loquor*, I speak).—A physical sign, connected with vocal resonance, heard on auscultation in some limited parts of the chest. The sounds of the voice in pectoriloquy are directly conducted to the ear, so that the words spoken by the patient may be distinctly recognised by the observer, as if proceeding from within the chest. *See* PHYSICAL EXAMINATION.

PECTORILOQUY, WHISPERING. — *See* WHISPERING PECTORILOQUY; and PHYSICAL EXAMINATION.

PEDICULUS.—Three species of lice are parasitic on man: (1) *Pediculus capitis*; (2) *Pediculus vestimenti vel corporis*; and (3) *Pediculus pubis*.

1. **Pediculus capitis.**—This species of pediculus infests the head, especially the occiput; and deposits its eggs on the shaft of the hair, usually not far from the root. The ovum is a small oval, semi-transparent body, somewhat cupped at its free extremity, and very firmly attached by a short peduncle to

the hair. The young are hatched in about five days. The louse when full-grown is about a line in length, the female being larger than the male. The head, thorax, and abdomen, which is oval, are distinct. The head is furnished with two short antennæ, and large, black, prominent eyes. Springing from the thorax are six well-developed legs, armed with strong claws, with which the animal grasps the hair. On the back of the male is seen a conspicuous, elongated, conical organ, the penis. The animal is of a semi-transparent, dirty-white colour, and is covered with short scattered hairs.

2. **Pediculus vestimenti.**—This species closely resembles in shape and general appearance the pediculus capitis, but is of larger size. It infests the underclothing, with a preference for that of a woolly kind, and it attacks and irritates the parts of the skin that are covered by clothes. The ova are deposited, not on the hair of the skin, but on the wool or fibre of the clothing, and the young are hatched in about five or six days.

3. **Pediculus pubis.**—This is much smaller and relatively shorter than either of the other species, and the line of separation between abdomen and thorax is less marked. The abdomen is short and rounded, which gives the animal a crab-like shape. Like the other species, it has six legs, armed with strong claws for grasping the hair. This louse infests the pubic region, and occasionally the axilla and hairy parts of the body and face, especially the eyelashes. The ova are found firmly attached to the hairs near the roots.

The different species of pediculi do not bite, as they have no jaws; but they pierce the skin and draw blood by means of a sucking apparatus or *haustellum*, and in this way they derive their sustenance from the human body. Regarded in a pathological aspect, the presence of pediculi is described as a disease under the name of *morbus pedicularis*, or *phthiriasis*. *See* PHTHIRIASIS.

ROBERT LIVEING.

PEDILUVIUM.—*See* BATHS.

PELLAGRA (πέλλα, the skin; and ἄγρα, a seizure).—SYNON.: *Erythema Pellagrosum*; Fr. *Pellagre*; Ger. *Pellagra*.—An erythema of the skin, indigenous to hot countries, and common among the peasants in Italy, Spain, and the South of France, which makes its appearance on the parts of the body most exposed to the light, especially the back of the hands, the neck, and the breast. *See* ERYTHEMA.

PELODERA.—A genus of 'free nematoids,' one species of which (*P. setigera*, Bast.) was found *post mortem* by Dr. Charlton Bastian as a parasite in the muscles of a boy who died of a febrile epidemic disease on board the 'Cornwall,' off Purfleet, in 1879, and whose body was exhumed after two months for examination. The suggestion was advanced that the pelodera was the cause of the fatal disease. This is, however, mere conjecture; and all distinct evidence as to the mode of infection, and as to the existence of the parasites in the body during life, is wanting.

PELVIC ABSCESS.—DEFINITION.—An abscess situated in the pelvis, and generally connected with some uterine or rectal affection.

ÆTIOLOGY.—The causes of pelvic abscess are: (1) Breaking down of tubercles; (2) Suppurative action, the result of broken-down hæmatocele or suppurating ovarian or extra-uterine cyst; (3) Inflammation of the pelvic peritoneum; and (4) Inflammation of the cellular tissue in connexion with the uterus, Fallopian tubes, ovaries, broad ligaments, and rectum, or the general cellular tissue of the pelvis. Malignant disease of or about the womb is sometimes accompanied by suppuration in the line of the lymphatics.

Pelvic peritonitis and cellulitis being often combined, pelvic abscess may arise from the joint action of these causes; and, indeed, after an abscess has arisen, it is very difficult, if not impossible, to differentiate as to its primary origin.

SYMPTOMS.—Pain of a shooting character, with increased local tenderness, accompanied by rigors, sweating, and pyrexia, supervening upon the symptoms of pelvic cellulitis or of pelvic peritonitis, will generally indicate the onset of the affection. *See* PELVIC CELLULITIS; and PELVIC PERITONITIS.

An abscess having arisen in the pelvis, it conforms to the same general laws as abscesses in other parts, its extension depending upon the relative firmness and tension of the surrounding tissues, an abscess generally burrowing in the direction of least resistance. Thus pelvic abscess may open in the following positions, singly or combined: 1. Through the abdominal walls and saphenous openings. 2. Into the pelvic viscera, as the bladder, rectum, vagina, or urethra. 3. Through the floor of the pelvis, near the anus. 4. Through the pelvic foramina, either obturator or sacro-ischiatic. 5. Through the pelvic roof into the peritoneal cavity. 6. Into the lumbar region, in the position of the kidney.

Such are the many and various courses which an abscess originating in the pelvis may take. Fortunately some of those enumerated are rare, such as opening into the peritoneum. No doubt its starting-point has much to do with its subsequent course, which admits of explanation chiefly on anatomical grounds. Should an abscess open into the peritoneum, then our trouble will no longer

be with the abscess, but with the peritonitis that ensues, so that we may lose sight of the primary disease in the gravity of the secondary lesion.

Should the abscess open into the rectum, we shall have a discharge of pus and fæcal matter from the bowel, often of a most fœtid character, especially if there be entry of gas into the abscess. On its opening into the bladder long-continued cystitis may supervene. Should a communication become established between these two organs, we shall have the indication of fæcal matter present in the urine.

Treatment.—Pelvic abscess must be treated as deep-seated abscesses in other parts of the body in the early stages, namely, by inducing pointing by hot fomentations or poultices; but when matter has formed the treatment will vary somewhat, according to the position the abscess takes: 1. When the abscess is threatening to point above Poupart's ligament, it is generally wisest not to use the lancet until the skin is seen to be definitely implicated; but when suppurative symptoms are well defined, it is a better plan to cut down with a scalpel, make a small opening, enlarge it with forceps, and, having washed out the cavity with antiseptics, to put in a drainage-tube and treat as usual in such cases. 2. When the matter is burrowing down the leg, or away from the pelvis, beneath the fasciæ, it must be treated according to the usual rules laid down in surgery for deep-seated abscesses beneath fasciæ, but the earlier we open the better. 3. Should the matter be in the floor of the pelvis, bulging into the vagina and rectum, and highly irritative symptoms exist, then it will be advisable to employ an aspirator, and, if pus be clearly observed, to open with full-sized trocar and cannula. When the fluid is evacuated, it is well to pass up a drainage-tube, carefully withdrawing the cannula, and leaving the tube in position, through which the cyst should be washed out twice daily with an antiseptic fluid, such as some preparation of iodine; the tube can be removed when the discharge ceases to flow. By some it is advised to make a free incision at first, plugging with antiseptic cotton or gauze, after washing the cavity out. Should hæmorrhage have occurred in the cyst, the difficulty of evacuation of its contents will be great; in this case it has been recommended to lay open the cyst with a bistoury.

The posture the patient assumes is also of importance—the pus should gravitate to the opening; thus, supposing the opening in the rectum or bladder, then the vertical posture will expedite the cure. In the same way any other position may be assumed which fulfils this end.

But of late there has been a tendency at an early period to explore, either by abdominal section or by dissecting down, according to the position of the pus. No doubt there are advantages in so doing, and thus serious burrowing is prevented, though diffuse abscess is less common than formerly when depletive measures were more used in the early stages. When the pyogenic cyst wall is thick and hard there is less danger of rupture or diffusion, but when it spontaneously opens it is often only partially emptied; and later on, after apparent cure, it re-gathers and discharges perhaps a third time.

A bandage round the upper abdomen assists in compressing the pus-cavity.

The general health must always be kept up by the administration of tonics, good food, and stimulants, so as to counteract the exhaustion due to the prolonged suppuration.

J. Braxton Hicks.

PELVIC CELLULITIS.—Synon. *Parametritis* (Schroeder, Virchow, and Matthews Duncan); *Perimetritis*.

Definition.—An inflammation of the cellular tissue surrounding the pelvic organs, both in the male and female, but much more frequently in the latter, and therefore more especially of the areolar tissue in connexion with the uterus and its appendages. Various views have been held with respect to the pathology of pelvic cellulitis, each author giving a name according to his idea of its origin; though, indeed, two distinct affections, pelvic cellulitis and pelvic peritonitis, are described under the general name of pelvic cellulitis.

Ætiology.—The causes of pelvic cellulitis are many and various, but it may be broadly stated that it may arise from any irritation to the mucous membrane, either of the uterus, vagina, or rectum, whether septic or benign. Of these the principal are traumatic, and consequently most cases are seen in connexion with the puerperal state, such as lacerations of the vaginal portion of os and cervix uteri, and after operations connected with the female genital organs; but in some persons, due no doubt to some remarkable idiosyncrasy of the patient, the passage even of a sound, or the retention of a pessary, slight cause as it may seem, is in itself sufficient to excite all the phenomena of pelvic cellulitis. Of the other than traumatic causes may be mentioned sexual excess, dysmenorrhœa, suppression of the menses, and gonorrhœa.

Anatomical Characters.—It was not until Nonat and Bernutz began to study the subject of pelvic cellulitis that any progress can be said to have been made in regard to its pathology. Nonat seems to have considered that the pelvic cellular tissue was chiefly the seat of this affection; whilst Bernutz, writing shortly afterwards, denied that the cellular tissue was in any way affected, and described it as an affection of the pelvic peritoneum; hence we have the term 'peri-uterine phlegmon'

of Nonat, and 'pelvi-peritonitis' of Bornutz. Virchow, and Matthews Duncan, following his suggestion, have used the terms 'para-metritis' and 'peri-metritis,' 'para-' signifying an inflammation of the cellular tissue, 'peri-' an inflammation of the serous membrane surrounding the uterus. Schroeder uses the term 'pelveo-peritonitis' in much the same way as Bernutz, and adopts the 'para-metritis' of Virchow. Cruveilhier, Champonierre, and Tilt have pointed out the share which they believe the lymphatics play in this disease, and to this they give the name of lymphangitis. The terms 'pelvic cellulitis' and 'pelvic peritonitis' appear in the Nomenclature of the College of Physicians, and we see no good reason to alter the names. Pathologically, no doubt, the distinction can be made in most cases, but clinically some difficulty arises, and many and various have been the computations as to their relative frequency. Schroeder points out that, even pathologically, the false cyst in pelvic peritonitis may become so thickened as to resemble that of pelvic cellulitis; and as the majority of cases tend towards resolution, and as there is a clinical difficulty as to diagnosis, coupled with their frequent co-existence, there must always be some diversity of opinion as to their relative frequency.

Pelvic cellulitis being caused, as we have said, by some irritation of the genital organs, the question as to the mode of its production, and the part which the different tissues take in its transmutation, has been frequently discussed. Some, after the suggestion of Dance, supposed that the venous system acted the part of the carrier in conveying the *materies morbi*. For a long time the profession were content to receive this as an explanation of the phenomena, until Cruveilhier and Champonierre showed the part which the lymphatics played in this disease. Besides this, there is reason to believe that, in those cases where the passage of a sound and such-like simple irritants are the cause of pelvic cellulitis, the nerves must play an important part, to account for such a rapid effusion of so much plastic material; although some insist that in all cases sepsis is the cause.

Pelvic cellulitis begins by an exudation of an albuminous nature into the cellular tissue. This, as in other cellular inflammations, may become absorbed, the fluid portion first, and the more solid portion at a later period; or, instead of ending in resolution, it may take on a retrograde metamorphosis, and end in abscess.

The exuded material thrown out in pelvic cellulitis follows the same steps wherever it may be situated in the pelvis, although its name and clinical symptoms vary according to its topographical distribution. But inasmuch as the effused material is thrown out into the cellular tissue near such a sensitive organ as the peritoneum, the inflammation is liable at any time to spread to and involve this membrane, by reason of its continuity. The peritonitis may either become localised, or may spread and involve the whole membrane, giving rise to general peritonitis; when the latter result occurs it is generally due to a septic cause, frequently spreading with extreme rapidity. It is highly probable that lymphangitis plays an important part in cases of this kind.

Symptoms.—A small amount of pelvic cellulitis may in itself give rise to very slight symptoms, perhaps merely a sense of uneasiness in the lower portion of the abdomen. This is often the case in slow recovery from the lying-in state, and may be overlooked, a vaginal examination not being deemed necessary, the symptoms varying much according to the rapidity and the quantity of the exudation. Should a large quantity be exuded, the most prominent symptoms will be more severe, namely, more or less tenderness on deep pressure, with dull aching pain in the pelvis, languor, and pyrexia; along with these there may be obstinate constipation and pain in defæcation. Dysuria also may be a prominent symptom. The presence of the last two symptoms will depend upon the situation of the effusion, and its pressure on the rectum and bladder.

Physical signs per vaginam.—In the early stage, there being only an effusion of fluid, its detection will be difficult; but as the matter becomes more solid, we shall be aware of a dense mass, usually limited to one or other side of the uterus, but if the amount be large, entirely surrounding the organ. This effusion is generally in the layers of the broad ligaments, either attached to or separate from the uterus, but usually fixed to it; and when the effused matter has had time to consolidate, it is of considerable hardness, similar to that of a uterine fibroid, but generally irregular in outline, often following the form of the roof of the vagina. A uterus fixed by hard, irregular, and immovable swelling is considered by some as pathognomonic of pelvic cellulitis. Pain running down the legs, on flexion and abduction of the thigh, owing to implication of the lumbar and iliac glands, and of the cellular tissue around the psoas and iliacus muscles, simulating hip-joint disease, is also a valuable diagnostic sign in some cases.

At the onset the temperature generally rises in the evening to 101° or 102°, rarely higher, and is lower in the morning.

The pulse is full in the benign cases; but in the septic form it is dicrotic, and towards the end in fatal cases becomes extremely so. The pulse and temperature form a valuable guide as to the state of the case. Favourable cases may recover in a few days, but generally go on for weeks or months, absorption gradually taking place, its duration depending

much on the general state of the patient and the amount effused. But should the case break down and end in abscess, the presence of this will be shown by increased pyrexia, probably rigors, and localised pain of a shooting character. For the signs of inflammation extending to the peritoneum, *see* Pelvic Peritonitis.

Diagnosis.—The diagnosis of pelvic cellulitis from the diseases with which it may be most readily confounded will be found in the articles on Pelvic Hæmatocele, and Pelvic Peritonitis.

Treatment.—When the pathology of pelvic cellulitis is fully considered, it will be seen that the treatment must depend upon the stage to which it has advanced. In the acute stage we should employ salines, and sedatives for the relief of pain, such as opium, chloral hydrate, and also quinine in full doses; and locally, hot fomentations applied to the lower part of the abdomen, and hot opiate and antiseptic injections given *per vaginam.* Iodoform suppositories are likewise useful employed continuously, combined with morphine if there is much pain. Leeches are often applied with much benefit to the groin, perinæum, or, still better, to the os uteri—three or four at a time, thereby removing any temporary congestion of those parts. The bowels are better moved by an enema than by purgatives given by the mouth, which if active may cause extension of the inflammation to the peritoneum. When the inflammatory action has subsided, the re-absorption of the plastic material which has been thrown out is assisted by the administration of tonics, as iron and quinine. Iodide of potassium is much relied on by some practitioners, and may be given with advantage combined with tonics; but probably the best means of promoting absorption is by restoring the general health by every method possible. The Americans and Germans recommend the vaginal douche night and morning for about twenty minutes; they believe that it acts as an absorbent as well as a sedative. In the septic variety much success has attended the exhibition of large doses of quinine, five grains every four hours having been given with advantage. In all cases rest is imperatively called for, even after the inflammatory stage is past.

J. Braxton Hicks.

PELVIC HÆMATOCELE.—Synon.: Peri-uterine Hæmatocele; Retro-uterine Hæmatocele; Pelvic Thrombus.

Nature.—Nélaton described this affection as a tense bloody tumour situated in Douglas's *cul-de-sac*, which pushed the uterus forward towards the symphysis pubis. Afterwards every bloody tumour in connexion with the pelvic organs came to be so described by some authors. Thus Dr. Robert Barnes classes ruptured uterus with an effusion of blood into the peritoneal cavity as an example of pelvic hæmatocele.

Any effusion of blood which takes place either from ruptured uterus or from other organs is not by most authorities now considered as true pelvic hæmatocele; indeed, blood effused from the liver, kidney, or other organ which has found its way into Douglas's pouch, might thus be included under this name. Pelvic hæmatocele consists of two varieties, to which the names of (1) *retro-uterine hæmatocele* or, better, *intra-peritoneal hæmatocele*, and (2) *pelvic thrombus* or *hæmatoma*, have been given. The first of these affections may be described as an effusion of blood into the retro-uterine sac, subsequently shut off from the rest of the peritoneum by an effusion of plastic material. The second variety, *pelvic thrombus* or *hæmatoma*, is an effusion of blood into the cellular tissue of the pelvic organs, and more especially of that in connexion with the uterus. Even with this limitation of applications, the frequency of pelvic hæmatocele has been variously stated by different authors; thus Scanzoni and Schroeder reckon it a rare disease, whilst Zeyfurt reckons it as occurring in 5 per cent. of all uterine cases. Inasmuch as most cases recover, the diagnosis must depend solely on a careful analysis of the clinical history.

It is well, however, that we should distinguish between the two affections, and we shall employ the term *thrombus* as applying to an effusion of blood into the cellular tissue around the uterus, and the term *retro-uterine hæmatocele* to blood which has gravitated into the peritoneal pouch between the uterus and rectum. These distinctions are important, inasmuch as they can in most cases be discovered both clinically and pathologically.

A. **Retro-uterine Hæmatocele.**—Ætiology. — The causes of retro-uterine hæmatocele are as follows: (1) Rupture of the uterine wall from any cause, including aneurysms and varices; (2) rupture of the Fallopian tubes from extra-uterine fœtation, and varieties of ectopic gestation; (3) ovulation with hæmorrhage; (4) rupture of varices in ovarian tumour; and (5) rupture of other viscera in the abdominal cavity.

Symptoms.—These will be the same as in the rupture of any viscus, and the escape of blood into the peritoneal cavity. Thus, there will be sudden onset of pain; pallor, with prostration and collapse, greater than can be accounted for by the anæmia; often vomiting, which is at times excessively severe. Nothing can be felt at first on physical examination, owing to the liquid state of the blood; but as the blood coagulates, hardness will supervene, displacing the uterus—the amount and direction of the displacement depending on the position which the blood assumes. This, as

has been pointed out, is generally to be found posteriorly, thus pushing the uterus forward, towards the pubes. In a short time inflammatory action may be set up, so as to limit the blood-effusion, and in this case it will not be of a severe peritonitic type; but, on the other hand, general peritonitis may be established, which may end fatally; or, again, the inflammatory process, having become limited by plastic material, may gradually become absorbed, or it may follow the usual course of pelvic abscess.

B. Pelvic Thrombus. — Ætiology. Pelvic thrombus arises from the contusions and lacerations resulting from normal and abnormal labour, from severe concussions of the pelvis, from interruption or suppression of the menses, from sexual excitement, and from rupture of the tube in extra-uterine fœtation between the layers of the broad ligament; or from hæmorrhage from diminished resisting power of the vessels, in the hæmorrhagic diathesis, scorbutus, or purpura.

Hæmorrhage which has thus arisen may follow the usual course of extravasated blood, namely, coagulation and absorption, or proceed to the formation of an abscess.

Symptoms.—These will depend on the amount of the effusion and its position. In general the quantity will be less than in retro-uterine hæmatocele. It is generally greater when it occurs in the layers of the broad ligament, which it may separate to a very considerable extent, reaching sometimes to the level of the umbilicus. However, blood effused into this position is necessarily under some restraint, though the pain would be thereby increased.

In this, as in the affection just described, we have a sudden onset of symptoms, but we do not have such marked anæmia, for the amount of the effusion is hardly so large. And we miss those symptoms of severe collapse which depend upon an effusion of blood into the peritoneal cavity. In fact, here we have more the symptoms of hæmorrhage *per se*, the effusion being situated outside the peritoneum, and therefore more restrained. We seldom have symptoms of peritonitis supervening, but rather those due to the displacement which the mass occasions, and consequent tension. The effusion may either be absorbed, or it may end in abscess, which pursues the usual course of pelvic abscess. *See* Pelvic Abscess.

Diagnosis.—These swellings, produced by blood-effusion, are liable to be confounded with many other troubles about the uterus. The most frequent position is in either broad ligament, where they may simulate fibroma, ovarian tumour, and especially cellulitis of the same part. The next position in frequency is behind, in the cellular tissue between the uterus and rectum, where the hæmatocele may imitate retroflexed uterus, or a tumour in Douglas's pouch. When the hæmorrhage is found at the roof of the vagina, or between the bladder and uterus, it gives the physical characters of a fibroma in the anterior wall, of pregnancy, or of cellulitis. It will thus be seen that the diagnosis depends much on a clear clinical history, either from the patient or her friends, which in some cases is difficult to obtain. In all cases of sudden accession of anæmia and collapse it is important to inquire carefully into the state of the menses, and to examine as to any pelvic tumour.

Treatment.—This divides itself into two parts, the first of which will be the arrest of the hæmorrhage (should it still be going on); and the second, the application of such means as tend to resolution and absorption of the coagulum. The first indication will be fulfilled by absolute rest, and the administration of hæmostatics, such as gallic acid, lead, turpentine, and other like remedies on which we are wont to place reliance for internal hæmorrhage, combined with an opiate. But inasmuch as vomiting is often a severe and prominent symptom, and medicines are with difficulty kept down a sufficient time to be of service, the opiate may have to be given by the rectum or hypodermically. Ice-bags or, if these are not at hand, cold lotions, should also be applied to the lower part of the abdomen, or even introduced *per vaginam*. At the same time a little ice may be given to suck. Stimulants, however, and hot drinks must be avoided. If, from the suddenness and severity of the collapse, it is supposed that a rupture of the cyst of an extra-uterine fœtation, or rupture of a varix of a twisted pedicle of an ovarian tumour, has occurred, it will be best to open the abdominal cavity, and treat the cause according to modern abdominal surgery; and this especially if, a tumour having already been observed in this region and rupture of an extra-uterine cyst supposed to be the cause, or rupture of an ovarian varix, it may be otherwise advisable to perform abdominal section.

The hæmorrhage having ceased without operation, we must still enjoin rest for some time, to prevent its recurrence, and to admit of the blood being absorbed.

In fulfilling the second indication, namely, the resolution of the extravasation, little will be required beyond keeping the system in good general health by the administration of tonics. Iron and quinine are of much service. Some practitioners rely on iodide of potassium as an absorbent; it may be given combined with quinine. Should a recurrence of the hæmorrhagic symptoms take place at different periods, the bromides and iodides have been considered of some value in quieting the action of the ovaries. But this recurrence shows a high probability of the case being one of ectopic gestation, and it

would be safer to open the abdominal cavity before it is too late.

If the case unfortunately end in abscess, the proper treatment will be that of pelvic abscess. *See* PELVIC ABSCESS.

J. BRAXTON HICKS.

PELVIC PERITONITIS.—SYNON.: Perimetritis (Bernutz, Virchow, and Matthews Duncan).

DEFINITION.—A local inflammation of that portion of the peritoneum which surrounds the pelvic organs, and especially the uterus and broad ligaments. *See* PELVIC CELLULITIS.

ÆTIOLOGY.—Pelvic peritonitis is often found as an extension from pelvic cellulitis, in both the puerperal and non-puerperal states. In the non-puerperal state it is associated with uterine flexions and versions; various operations on the genital organs; rupture of ovarian cysts; abscess of the ovary; escape of blood from the Fallopian tube; extension of irritating secretions along the Fallopian tube from the uterus, such as gonorrhœa, pus (pyo-salpinx); bursting of the tube; malignant disease; and tubercle.

ANATOMICAL CHARACTERS.—Here, as in cellulitis, the part which the veins, lymphatics, and nerves take is still open to controversy; but the lymphatics, no doubt, take the most important part in those cases where the change commenced in cellulitis. But the relative frequency of the tubes as a source of peritonitis is still in doubt, though as conveyers of irritating material they bear a very important part.

Whatever the origin of the peritonitis, we have, in the first place, an effusion varying in character—either serous, plastic, or purulent. The serum may either be absorbed, or become encysted by plastic material, and form a false cyst, which, in an unhealthy condition, may be of a pyoid nature, forming an abscess having the usual characters of pelvic abscess.

But there is this difference from the exudation of pelvic cellulitis and that of pelvic peritonitis, namely, that in cellulitis the exuded material may be absorbed, leaving but few, if any, relics of the bygone inflammation, whilst in peritonitis the fluid portion is chiefly absorbed, leaving very often strings or bands of adhesions matting together the various organs. A not uncommon occurrence is for the uterus, if previously retroflected, to be bound down posteriorly to the sacrum, but it may be equally fixed in any other direction in which effusion has been poured out. The effect of these adhesions is sometimes curious, for the ovary has been found rent from its attachment, and fixed to the pelvic brim posteriorly. These adhesions may stretch and give rise to no permanent displacements, but at other times they are irremediable. Pregnancy seems to have most influence in their removal; and, indeed, this has been suggested as a method of cure. In the same way they may hinder the action of the uterus in labour, and cause pain by their rigidity, though they often hinder conception or give rise to abortion, and sometimes to severe and even fatal obstruction of the bowels. The influence of adhesions should always be borne in mind after any case of pelvic peritonitis.

Should the case end in abscess, it may open in any of the ways given under the head of PELVIC ABSCESS.

SYMPTOMS.—In chronic and subacute cases of pelvic peritonitis, the symptoms are usually obscure, the patient (often after childbirth) complaining only of a dragging sensation at the lower portion of the abdomen. These cases frequently pass unnoticed, rest in bed and other remedies sufficing to effect a cure.

In acute cases, the symptoms begin with complaint of a severe pain, increased by pressure, with fixedness of the abdominal muscles in the lower portion of the abdomen, or the coils of the intestine may be seen mapped out. Along with this there is usually a wiry pulse; but if the disease be of septic origin, it may be dicrotic. The temperature is usually above 102°, but varying night and morning. We may also notice a Hippocratic expression of the countenance. Should this become marked we should have reason to fear an extension to the general peritoneum. At the same time we may have constipation, and generally severe vomiting; and by pressure of effused material on the bladder and rectum, there may also arise constipation and dysuria. *Per vaginam*, we may discover a tumour laterally high up in the pelvis, and not easily felt, both on account of the distance from the examining hand, and from the severe pain to which examination gives rise.

But, again, it must be pointed out that cases do occur in which nearly all the symptoms are wanting, although the attack may be of a most malignant type, the rapid pulse and pyrexia, coupled with a peculiar expression of the countenance, being almost our only guide. A vaginal examination fails to give us any indication as to its nature, owing to the matter being purulent and fluid. These cases are almost always of septic origin.

DIAGNOSIS.—Pelvic peritonitis may be diagnosed from pelvic cellulitis by the following considerations:—

Pelvic Cellulitis.

1. Tumour easily reached; generally easily and early felt *per vaginam* in neighbourhood of broad ligament, and also above pelvic brim.

2. Abdominal pain, increased by deep pressure.

3. Temperature usually not above 102°; pulse large, soft, dicrotic in septic form.

4. Retraction of thigh with abduction. Pain down leg.

5. Nausea; vomiting, not excessive.
6. Not accompanied by tympanites.
7. Marked tendency to suppuration.

Pelvic Peritonitis.

1. Tumour not noticeable for some days.
2. Abdominal tenderness of an acute kind, quickly increased on pressure. Form of coils of intestines mapped out on abdomen. Fixation of abdominal muscles.
3. Temperature above 102° usually; pulse wiry in benign, dicrotic in septic form.
4. Pain down leg and retraction of thigh never present.
5. Nausea; vomiting excessive.
6. Tympanites present in severe cases.
7. Constipation, often marked.
8. Suppuration not often present.

Treatment.—In all cases of pelvic peritonitis, whether acute or chronic, our chief point is rest, and this cannot be too rigidly insisted upon. The stage of the disease, whether chronic or acute, will indicate the amount. Should the case be of a subacute nature, then reclining on a couch will be all that is necessary; but should, on the other hand, the case be acute, however limited in area, then it is essential that we should order absolute rest in bed, as little movement as possible being allowed. In chronic cases this point must be left to the discretion of the physician; it will be for his consideration what part the local condition bears in relation to the general health, and whether continuance of the local trouble will not cease on restoration of the general health.

The next point to be considered—and we know of none in which so much mischief is done by want of appreciation of the true condition—is the administration of purgatives in the acute forms. The same rule holds good here as in the treatment after an operation for hernia, namely, that any increased peristaltic movement of the intestines is liable to cause an extension of the peritoneal complication. We must bear in mind that what the inflamed peritoneum wants is rest, to lessen the friction of the surfaces; and should any unhealthy matter be present, time is urgently required for the effusion of a limiting plastic material, to shut it off from the rest of the abdominal cavity; and after its formation, still further repose is necessary to prevent its being broken down. Thus it is that we find our sheet-anchor lies in the administration of full doses of opium, which not only allays the sensitiveness of the peritoneum, but limits the peristaltic movement of the intestines. If the bowels are unrelieved for fourteen to eighteen days, no harm will accrue. A mild enema of olive-oil and gruel will be the best measure to adopt where necessity requires relief.

In the more chronic cases, for the same reason, we should never purge our patient, for there is always a risk of extending the inflammatory action to the general peritoneum; a mild laxative daily, or, better, an enema, will answer every purpose.

If, from the severity of the constitutional symptoms and the absence of the local, we have reason to believe that we have a case of septic origin to deal with, quinine must be given in large doses, say five grains every four hours, by mouth, by the bowel, or hypodermically. Very marked results have attended the exhibition of this drug in cases otherwise almost hopeless. Sixty grains a day have been given without ill result—indeed with the cure of the patient. Should the peritonitis appear to be of a purely sthenic form, the employment of the old remedy, mercury, will generally be found to be a valuable addition to that of the opiates, at any rate for a short time; but in any case great caution is required lest diarrhœa be induced. In this form the employment of leeches to the abdomen will also assist in the reduction of the inflammation. Care, however, must be observed not to debilitate the patient. Hot opiated fomentations to the lower part of the abdomen in all cases afford great relief. But of late, in cases where there is reason to believe that the inflammation has originated in some local disease, as pyo-salpinx or ovarian suppuration, and where the symptoms are severe or have been recurrent, it is advised that exploration of the peritoneal cavity should be made, the unhealthy cause removed, and the cavity well cleaned or flushed with sterilised water. Should the case lapse into a chronic state, iodide of potassium may be of some service in aiding the absorption of the inflammatory products. The bromide has also been given with the idea of lessening congestion and quieting the action of the ovaries.

At a later date much good will result from the administration of tonics, and from change of air, the local trouble being often kept up by the general condition.

In recurrent cases, where an exploratory abdominal operation is refused, or where it is for other reasons undesirable, the use of antiseptic injections *per vaginam*, or the use of iodoform pessaries, or those of kindred sort which extend their influence beyond their position, inserted into the upper vagina daily, will be found of much service in preventing recurrence. Or the inside of the uterus may be swabbed out with iodised phenol, tincture of iodine, or the solution of perchloride of mercury, after dilatation of the os and cervix. For doubtless the morbid material, in many instances, starts from the interior of the uterus—in cases particularly of small os and cervical canal.

Such are the chief indications of treatment. Vomiting, dysuria, and other complications must be treated on general principles.

J. Braxton Hicks.

PEMPHIGUS (πέμφιξ, a bladder).—Synon.: Pompholyx; Fr. *Pemphigus*; Ger. *Blasenkrankheit*.

Definition.—A somewhat rare skin-disease, of indefinite duration; in which blebs or bullæ, containing serous or sero-purulent fluid, form in greater or less numbers on various parts of the body and limbs; burst; dry up, and produce crusts; and finally disappear, leaving temporary stains.

Ætiology.—Pemphigus occurs about once in 500 cases of skin-disease in England. It is much more frequent in children than in adults, and most frequent in the first eighteen months of life. In adults all ages are nearly equally disposed to it.

In childhood females seem slightly more disposed than males. Pemphigus foliaceus is more frequent in women. Neither geographical distribution, season of the year, nor any special diet or habits of life seem to affect the development of the disease. It occurs in persons of all temperaments, and in the healthy as well as in the delicate. No definite relation can be traced between derangements of the kidneys and pemphigus, nor between the latter and the gouty or rheumatic diatheses. In a few instances there has been a distinct relation between pregnancy and the outbreak of bullæ. Pemphigus is never endemic. Various epidemics, chiefly among children, have been described by trustworthy writers, of which the latest occurred in 1869 at Halle, and in 1874 in Paris, both in new-born infants, but it seems doubtful whether these were cases of true pemphigus, and not rather allied to varicella. Outbreaks of pemphigus have appeared in more than one case to be determined by a local injury, such as a puncture of the finger. There are one or two instances known in which the disease has been transmitted hereditarily.

Bullous eruptions frequently occur in connexion with lesions of the nervous system, either central or peripheral, for example, general paralysis, sclerosis of the lateral columns, locomotor ataxy, or injury to nerves.

Pemphigus is a non-contagious disease, and all attempts to transfer it from one person to another, by inoculating the contents of the bullæ, have failed.

Anatomical Characters.—In pemphigus the capillaries of a circumscribed portion of skin are dilated with blood, and this hyperæmia is followed by exudation from them of serous fluid, which infiltrates the papillæ and the cells of the rete mucosum, and finally makes its way beneath the epidermis, so as to raise and separate its uppermost layers from the parts below, thus forming a bulla or bleb. The parts of the epidermis which are connected with the hair-follicles resist the pressure longest, but at length give way, and their remains then hang from the under-surface of the covering of the bullæ as small threads or processes.

The contents of the bullæ consist at first of nearly pure serum, which gives on heating a flocculent deposit of albumen; later on the fluid contains numerous pus-cells, probably due partly to migration of white blood-corpuscles, and partly to proliferation of the rete cells. Occasionally it contains small quantities of blood exuded from the surface of the cutis. The reaction is at first neutral, but is faintly alkaline in the older bullæ. The bullæ have been found to contain micro-organisms, phosphates, chlorides, cholesterin, urea, uric acid, &c., but not in sufficient quantities or with sufficient constancy to confer any ætiological importance.

No *post-mortem* examination has as yet revealed any constant alteration in the organs or tissues which would account for pemphigus. General anæmia, and wasting of the muscles and other parts, have been found in uncomplicated cases, while some patients have died of intercurrent pneumonia and of phthisis. In more than one instance amyloid degeneration of the liver and spleen has been found, just as in other chronic wasting diseases.

Description.—Pemphigus may occur without apparent assignable cause in a previously healthy child or adult. The bullæ may form on a perfectly normal skin, or else a circumscribed portion of skin becomes hyperæmic, and the epidermis over it is raised by a rapid effusion of serum into a bulla, which enlarges quickly, so as to overhang its base. The bullæ are mostly hemispherical in shape, and may reach the size of an orange, or larger; but, as a rule, they vary from that of a pea to that of a hazel-nut or walnut. Their contents are at first clear and transparent, but in a day or two they become milky and opaque, and finally purulent. The coverings, previously tensely filled, burst; and the discharge dries into flat yellow-brown or blackish crusts. The bullæ tend to a symmetrical distribution on the two sides of the body. They may also spread peripherally, fresh bullæ forming at the edge of the crusts or stains of old ones. There is no areola at first, but as the contents become purulent, a narrow red areola is seen. At the same time as the skin is affected, small bullæ sometimes form on the mucous membrane of the mouth, nose, and pharynx; and they have been seen with the laryngoscope on the posterior surface of the epiglottis. They have also been found *post mortem* on the mucous membrane of the bronchi and of the intestines, and are probably the cause of the diarrhœa and bronchitis from which pemphigus patients sometimes suffer. Pemphigus has a marked tendency to recur at longer or shorter intervals, each outbreak being made up of a number of successive crops of bullæ. A few bullæ may in no way affect the general health, but if they are numerous they may be preceded

by rigors and fever—102° to 103° F.—and even by delirium and other cerebral symptoms in children. The disease may terminate after one or two attacks, or may recur at intervals and with increasing severity for years, until the patient is reduced in health and strength, and finally dies in a marasmic state, or of some intercurrent disorder.

Classification.—We may divide pemphigus into four main varieties: (1) *P. neonatorum*; (2) *P. acutus*; (3) *P. chronicus*; and (4) *P. foliaceus*. Other varieties, such as *P. solitarius*, when only one bulla exists at once; *P. gangrænosus*, where ulcers succeed the bullæ; and *P. pruriginosus*, where itching is a conspicuous symptom, have been described, but they scarcely merit detailed notice. *P. vegetans* is described as a very fatal form of the disease, which begins as white patches in the mouth or pharynx, bullæ afterwards appearing on the hands, feet, axillæ, and groins, and fungating into papillary outgrowths, secreting a viscid offensive discharge. It has been thought to be of syphilitic origin.

1. *Pemphigus neonatorum* is an acute bullous eruption occurring in infants, not to be confounded with syphilis, but due probably to septic causes, in connexion with the surroundings during lying-in.

2. *Pemphigus acutus*.—By this we understand a bullous eruption which occurs only once in the same individual, has a short duration of from three to six weeks, and generally terminates in complete recovery. The existence of such cases, which was at one time doubted, is now certain. In its general symptoms *P. acutus* resembles the acute specific diseases. There is a prodromal stage, a rigor and great prostration; and albumen may appear in the urine (Senftleben). Fatal cases have occurred.

3. *Pemphigus chronicus seu vulgaris*.—This, the *P. diutinus* of Willan, is the most usual form, and the one to which the above description mainly corresponds. This form may assume a malignant character by the number of bullæ present at one time, and by their prolonged duration and rapid recurrence, so that the patient's health is undermined.

4. *Pemphigus foliaceus* (Cazenave).—Under this name has been described a form of pemphigus of a peculiarly malignant character. The bullæ are irregular in outline, flat and flaccid, and purulent from the commencement. Other bullæ form round each central bulla, or else the latter spreads peripherally *per continuum*, until at last the whole surface of the body may become involved. At the same time the skin does not heal over the situation of the older bullæ, but remains moist and raw, and covered either with crusts like those of impetigo, or else with the loosened coverings of the bullæ, which form large lamellæ or scales, from which the disease derives its name. The scales have been likened to flaky pastry. This form is happily extremely rare, for it is always fatal. *P. foliaceus* may assume the characters above described from the first; more often the disease develops from an ordinary *P. chronicus*.

Complications.—Pemphigus has been seen occurring simultaneously with small-pox and with purpura. Several cases have been reported in which a form of pemphigus occurred in the early weeks of pregnancy, and continued until delivery. In one case the disease recurred during several successive pregnancies. *Pemphigus pruriginosus* is a name which has been given in cases where the disease has been accompanied by severe pruritus, probably a form of the disease formerly described as hydroa, now known as dermatitis herpetiformis (Duhring).

Diagnosis.—The fully developed eruption of pemphigus is too characteristic for it to be mistaken for any other disease. The diagnosis may be difficult at the onset, when only a few bullæ have appeared, or else towards the termination of an attack, when only scabs or stains are left; in the first case the absence of cuniculi will distinguish it from some rare cases of scabies of a purely bullous form. At the outset it may be also necessary to distinguish its bullæ from those occurring in erysipelas, from the use of artificial vesicants, from burns, and from the friction of shoes, clothes, or contiguous portions of skin. The bullæ of herpes iris invariably commence on the backs of the hands and feet; run a rapid course; and assume a concentric circular character. The bullæ which not infrequently occur in anæsthetic leprosy can scarcely give rise to difficulty, when taken in connexion with the maculæ and other phenomena attending it. In long-standing cases of pemphigus, portions of skin which are extensively denuded of their epidermis may take on a considerable resemblance to eczema rubrum; but the history, the emaciation and weakness of the patient, the dark staining of the skin, with absolute absence of infiltration and only slight irritation, will render it easy to form a decided opinion. Syphilitic pemphigus is distinguished from true pemphigus by occurring only in new-born children; by involving principally, though not exclusively, the palms and soles; by leaving the mucous membranes unaffected; and, lastly, by forming thick crusts when the bullæ burst, under which deep ulcers form. The diseases which are most likely to be confounded with ordinary pemphigus are erythema (bullous forms), urticaria bullosa, hydroa, and varicella bullosa. *P. foliaceus* may simulate eczema rubrum, lichen ruber, and pityriasis rubra in their later stages, and when the skin is extensively involved.

Prognosis.—This is favourable in the early

attacks, but doubtful as to the ultimate result, since it is impossible to say whether the disease may end with a single attack, or go on to gradual exhaustion of the patient's strength in the later ones.

Treatment.—No specific remedy for pemphigus has as yet been discovered; the nearest approach to one is arsenic, which in some cases of relapsing pemphigus, especially in early life, exerts a marvellous action on the disease, not only removing all traces of it for the time, but restraining its further invasion during long periods (Hutchinson). In other cases all drugs are equally powerless. The treatment which finds most general approval consists in the administration of tonics, especially quinine or bark and iron, and in supporting the strength of the patient by nourishing food and wine. Locally, ointments of zinc or boric acid may be tried, but probably lotions of lead or calamine will give most relief, combined with dusting powders, such as starch and zinc, or powdered cimolite. Pricking the tense bullæ sometimes relieves. In the pruriginous form, preparations of tar, and warm baths, may be tried. In some cases bran baths, and in others alkaline baths, have been found beneficial, but it is impossible to lay down any line of treatment suitable to all cases.

Edward I. Sparks. Alfred Sangster.

PENIS, Diseases of.—Synon.: Fr. *Maladies de la Verge*, or *du Penis*; *Krankheiten der Ruthe*, or *des Penis*.—Taken in the widest sense, the diseases of the penis include a number of conditions which are separately described in this work, such as diseases of the urethra, gonorrhœa, balanitis, gleet, syphilitic and other sores of venereal origin, and priapism. For a discussion of these subjects the reader is referred to the articles under their several designations. In this place there remain for consideration the following morbid states: (1) Congenital Abnormalities; (2) Phimosis, congenital and acquired; (3) Adherent Prepuce; (4) Preputial Calculi; (5) Paraphimosis; (6) Inflammation from various causes; (7) Gangrene; (8) Herpes Præputialis; (9) New-growths, benign in character; (10) Cancer and other Malignant Growths; and (11) Elephantiasis.

1. Congenital Abnormalities.—Various abnormalities of the penis are from time to time met with, which are more or less important according to the difficulties in micturition or sexual intercourse to which they may give rise, and the consequent ill effects upon the personal comfort and general health. Among these may be mentioned certain rudimentary conditions of the whole organ, associated or not with defective development of other parts of the genito-urinary apparatus, such as—undue smallness or even deficiency; disproportionate largeness; torsion or lateral deviation; in extremely rare cases multiplication (double or triple penis); abnormalities in excess or deficiency of particular parts of the organ; epispadias; hypospadias; and phimosis. The three last named require special notice.

(*a*) **Epispadias.**—Definition.—A condition in which, from arrest or defect in development, the upper parts of the urethra and corpus spongiosum are wanting, and the corpora cavernosa are not properly closed together; and in which, consequently, the penis appears more or less completely fissured or opened along its dorsal aspect, and the floor of the urethra is exposed.

This condition is most frequently associated with ectopia vesicæ (*see* Bladder, Diseases of); but the defect may be limited to the penis. In most instances the prepuce is long and pendulous below the glans; and this is important, inasmuch as it may often be advantageously used in remedial plastic operations.

Symptoms and Effects.—The attendant inconveniences and discomforts, such as the continual flow or incontinence of urine, and unfitness for sexual congress, though varying somewhat in degree with the extent of the defect, are so great and so constant, that any reasonable attempt at remedy by plastic operation may be considered justifiable. It must be confessed that such attempts have hitherto resulted much more frequently in failure than in success. In some cases, however, much good has been effected; and in other cases the patients have been enabled to wear apparatus by which their discomfort has been materially diminished. For a description of the various methods adopted, reference must be made to surgical works.

(*b*) **Hypospadias.**—Definition.—A condition in which, from defective development of the urethra and of the corpus spongiosum, the urethra opens on the under-surface of the penis, at a variable distance behind the glans; and in which, during erection, the penis arches more or less downwards and backwards. The prepuce usually forms a kind of flap, which overhangs, but does not surround the glans.

Symptoms and Effects.—The opening of the urethra, which is often very small and slit-like, may be situated either, first, immediately behind the glans; secondly, at any point in the under-surface of the body of the penis; or, thirdly, just in front of the scrotum. In the first case—by no means an uncommon condition—no material inconvenience results: micturition and sexual intercourse can, as a rule, be fairly well accomplished; and there is no call for surgical interference beyond the enlargement, if needful, of the urethral orifice. But in the second and third class of cases, in which the urethral orifice is far back, the urine passes down the thighs or

backwards; complete sexual intercourse is rendered difficult, painful, or altogether impossible; and the semen cannot be properly intromitted. Such a state of things often occasions great mental distress, and, thereby, impairment of health; and it may become justifiable and desirable to attempt to remedy to some extent the defect by surgical operation. A great variety of methods have been devised and practised, the details of which will be found in surgical treatises. Most of them have resulted in complete failure. But in some few instances very considerable improvement has been effected, within the experience of the writer. As a rule, operative measures should be delayed until adult life is reached.

2. **Phimosis, Congenital and Acquired.** — Definition.—A condition, often congenital and hereditary, but not infrequently acquired or exacerbated as the result of inflammatory processes, in which the orifice of the prepuce is so small as to render it difficult or impossible to uncover the glans properly and to the full extent.

(*a*) *Congenital phimosis.*—In some cases the orifice is a mere pinhole, or even scarcely discoverable; in others more or less of the glans may be exposed to view. Associated with this, as a congenital condition, there is often elongation of the prepuce, usually shortness and tightness of the frænum, and as a rule also undue smallness of the urethral orifice.

It is very important that the existence of congenital phimosis should not be overlooked or ignored, for at all periods of life more or less serious troubles may arise from it; and accidental circumstances, such as injury, inflammation, ulceration, may easily convert a comparatively slight *congenital phimosis* into a severe so-called *acquired phimosis*. At all ages phimosis is liable to interfere with free micturition—in severe cases from mechanical obstruction (sometimes the prepuce gets distended, bladder-like, during attempts at micturition), in less severe, or even comparatively slight cases, from reflex irritation and spasm. The bladder consequently may not be properly evacuated, and gradually cumulative mischievous results may ensue.

Symptoms and Effects.—In infancy and childhood frequent attempts to pass water, accompanied by straining and sometimes screaming; the passage of a small stream, or of a small quantity at a time followed by sudden stoppage; subsequent dribbling of the water; irritation and inflammation about the prepuce; and pulling at the penis—these are signs and symptoms accompanying and suggestive of phimosis in the first place, however closely they may simulate the indications of stone in the bladder. General irritability and deterioration of health, the production of hernia by frequent straining, balanitis, the formation of subpreputial calculi, the acquirement of the habit of masturbation, and reflex paralyses, are among the evil results that may arise.

In adult life, local discomfort, slowness of micturition, imperfect evacuation of the bladder, with all its probable consequences; smallness (from adhesions and compression) of the glans; difficulty, want of pleasure, or even actual pain in sexual intercourse; and liability to infection during impure intercourse, are troubles more or less constantly affecting the subject of phimosis; and to these may be added, in more advanced life, increased liability to cancer of the penis. As to this last named risk there is no doubt in the mind of the writer, judging from his own observation, as well as from the recorded observations of others, although of late it has been disputed.

Treatment. — In comparatively slight cases of phimosis the prepuce may be gradually stretched, and its orifice dilated to the needful extent, by frequently repeated gentle efforts at withdrawing it, and by inserting, between times, strips of dry or oiled lint between it and the glans, or by the use of one or other of the mechanical contrivances that have been suggested. In the more severe cases resort to operation is needful. And it would probably be better if radical operation were resorted to at once in all doubtful cases. The methods variously adopted are: (1) Forcible tearing; (2) Linear incision to greater or less extent; (3) Excision of a portion of the prepuce; and (4) Circumcision. The first method is clumsy and altogether to be condemned; the second is easy to perform, but often leaves the part in an awkward condition; the third is incomplete, and rarely satisfactory in effect; the fourth, if carefully and skilfully carried out, is uniformly successful, yields excellent results, and, as a rule, is to be recommended.

The best method of performing circumcision consists in first slitting up the prepuce along the median line on the dorsal aspect, by means of a bistoury or scissors, guided by a director, to a point on a level with or rather behind the corona, and then starting from this point, and with scissors cutting all round, dividing skin and mucous membrane evenly together, the skin and mucous membrane being stretched and held by broad-bladed forceps. As a rule, the frænum should be cut; indeed, in most cases it is better to excise a portion, or the whole. In the infant, sutures are not necessary; but in the adult it is better to stitch the edges of the skin and mucous membrane together by very fine sutures inserted as close to the edges as possible. Inrolling is thus prevented, and if the sutures are tied very tightly they will ulcerate out, and the pain and trouble of removing them will be avoided. The simplest dress-

ing only is requisite; but the parts must be kept scrupulously clean, and free from all irritation.

(*b*) *Acquired phimosis.*—This condition may arise as a result of repeated attacks of inflammation, with or without chancrous ulceration, followed by induration, thickening of the prepuce, and contraction of its orifice. It is most frequent in those who have had slight congenital phimosis.

Treatment.—Circumcision is the proper treatment in all cases if the inconvenience and trouble should be at all considerable.

3. **Adherent Prepuce.**—In some cases of phimosis, and occasionally even in some cases in which the preputial orifice is not unduly small, the mucous membrane of the prepuce adheres, to a greater or less extent, to that of the glans. The smegma and other secretions are thus confined; and considerable local irritation, accompanied by more or less severe symptoms, may be set up. Such symptoms often closely simulate those of stone in the bladder.

Treatment.—The foreskin must be drawn gradually back, the adherent surfaces being separated during the process by the flat end of a probe or other thin blunt instrument; the confined secretions must be removed; the parts washed; the prepuce replaced; and strict cleanliness enjoined, the prepuce being daily withdrawn and replaced after washing. In severe cases circumcision should be performed.

If this condition be overlooked during infancy, the adhesions become firm and dense, and seriously impede the growth of the glans. Their division in the adult may require the use of the knife during circumcision.

4. **Preputial Calculi.**—The subpreputial secretions, if allowed to remain and accumulate, occasionally undergo changes, and become formed into hard concretions, which give rise to more or less serious discomfort and inconvenience. The diagnosis is easy and simple. Such concretions are found to consist mainly of phosphate of lime and ammonio-magnesian phosphate, with a variable amount of organic matter. Many cases are on record in which preputial calculi, remarkable for their size and number, have been removed. After slitting up the prepuce and removal of the calculi, circumcision should be performed.

5. **Paraphimosis.**—Definition.—Paraphimosis is a condition in which a tight foreskin, having been forced back, during coitus or otherwise, has led to strangulation, œdema, and inflammatory swelling of the glans and a portion of its own mucous membrane and skin. The appearance presented is most characteristic, and cannot be mistaken.

Treatment.—Reduction must be effected at the earliest possible moment. If the case be neglected, severe inflammation, ulceration, and sloughing to greater or less extent, followed by more or less permanent deformity, are liable to ensue. The method ordinarily adopted consists in grasping the body of the penis between the middle and forefingers of both hands, drawing the foreskin forwards, and at the same time compressing and pushing back the glans by both thumbs. This method is very painful and not always readily successful. A better method, which very rarely fails, consists in slowly bandaging the glans (beginning at the extremity), and all the swollen parts, with a piece of narrow elastic webbing, the effect of which is gradually to empty the engorged vessels and squeeze out the serum from the swollen parts. On the removal of the bandage after a few minutes, reduction is, as a rule, very easily effected. The process may be facilitated by a few needle or lancet-point punctures, made before the application of the bandage, to allow escape of serous effusion, and so diminish the swelling.

In some neglected cases it may be needful to divide the constricting band by means of a bistoury. In attempting this, it must be borne in mind that the constriction is not immediately behind the glans, but behind the swollen portion of the preputial mucous membrane.

After reduction, cooling and soothing applications (as, for example, lead and opium lotion) should be used, and the question of circumcision should be subsequently entertained.

6. **Penis, Inflammation of.**—Synon.: *Penitis*; *Cavernitis.*—Inflammation of the penis in its totality is comparatively rarely met with except as the result of injury, or in association with severe venereal diseases. In some instances it is said to have been induced by excessive sexual intercourse, and in other instances by persistent masturbation. Many cases, however, are on record in which it has occurred in association with the sequelæ of exanthematous fevers and diphtheria.

Inflammation of the penis occurs sometimes in *gouty subjects*, and may give rise to thrombosis in the corpora cavernosa or corpus spongiosum, or to fibrous deposits leading to indurations in the sheaths, or to hard nodules, which are very slow to disappear.

Diabetics are also liable to inflammation of the penis.

Treatment must be conducted on general principles, due regard being paid to the cause or condition in connexion with which the inflammation has arisen. If the patient survive, the part may recover under appropriate management.

7. **Penis, Gangrene of.**—Gangrene of the penis, except as the result of injury, or

constriction by ligature, rings, &c., in the majority of cases has followed impure sexual congress during a depressed general condition. In some cases it has occurred in association with small-pox, typhus, and typhoid fevers and diphtheria. Death has been the common result. In some cases life has been preserved, though the part or some portion has been lost.

8. **Herpes Præputialis.**—This is a vesicular eruption, occurring on the cutaneous or mucous surface of the prepuce, running its course in about a week, but liable to recur at irregular intervals. A similar eruption sometimes occurs on the glans. *See* HERPES.

The due recognition of this affection is important, because its appearance after doubtful intercourse often excites alarm, and may lead to mischievous treatment. *See* SYPHILIS; and VENEREAL DISEASE.

TREATMENT.—The simplest treatment only is requisite. The avoidance or prevention of all irritation by the clothes or otherwise, and sometimes a little sedative lotion, are, as a rule, all that is needful.

9. **Penis, Benign New-Growths of.**—*Cystic*, *vascular*, *fibrous*, *horny*, *fatty*, *sebaceous*, and other new-growths of benign character are occasionally situated on the penis. They may be left uninterfered with, or may be got rid of by operation, according to the inconvenience they cause, and the indications afforded. *Bony formations*, *calcareous deposits*, and *fibroid nodules* in the fibrous sheaths of the corpora cavernosa are of rare occurrence. The discomfort they have in some instances caused has necessitated their removal by operation, which has been successfully accomplished.

Papillomata, or warty growths, are not infrequently met with in persons of uncleanly habits. In the majority of cases they are associated with venereal disease; but they may arise independently of such association, especially if the prepuce be long and due regard be not paid to cleanliness. They may be few and scattered, or many and massed 'caulifiowerlike' together. Sometimes they entirely surround the corona, and sometimes in patches or continuously cover more or less completely the mucous surfaces of the prepuce and glans. In some instances the diagnosis between such growths and papillary epithelioma is not obvious; ulceration of surface indicates the latter.

TREATMENT.—Removal by curved scissors, or twisting off by forceps, is the most speedily effectual treatment of papillomata of the penis. But if the warts are few and small, they may be made to shrivel and dry up and disappear by repeated applications of oxide of zinc, calomel, tannic acid, or burnt alum, and the pressure of dry lint between the foreskin and glans. Cleanlincss is essential.

10. **Penis, Malignant Growths of.**—Cancer in the male subject in a considerable proportion of cases primarily affects the penis. By far the most common form is *epithelioma*; and the most common seat of first appearance is the glans, or the part of the preputial mucous membrane nearly or immediately adjoining. In comparatively rare cases *scirrhus* is described as having commenced 'lump like' in some part or other of the body of the organ. In still more rare cases, '*soft cancer*' (probably small round-celled sarcoma) has been recorded as having occurred in young subjects after injury, and the diagnosis from suppuration in the corpus cavernosum has at first been doubtful. Sarcoma and melano-sarcoma have been met with in a notable number of cases, affecting primarily, as a rule, the fibrous sheaths of the corpora cavernosa.

Epithelioma seldom appears in the penis before the age of forty, most frequently between the fiftieth and sixtieth years. In 161 cases out of 243 the sufferers had been the subjects of phimosis. In some few instances the origin of the malady has been attributed, rightly or wrongly, to marital connexion with wives suffering from cancer of the uterus. Epithelioma is first noticed as a small warty outgrowth, early ulcerated; or as a flat excoriated surface, with slightly indurated base, occasionally disposed to bleed, and sometimes painful. Scabs form from time to time, which, when removed, leave exposed a gradually extending ulcerated surface. Sometimes what seemed a benign papillomatous growth ulcerates, and assumes a malignant character. The malady persists and progresses in spite of treatment, infiltrating and destroying. The discharge is thin and sanious, bloodstained and offensive. The ulcer is irregular in outline, with more or less everted hard edges; and the induration extends into the surrounding parts. Sooner or later the inguinal glands become infected, and the general health seriously deteriorates.

DIAGNOSIS.—The diagnosis of cancer of the penis from any form of venereal ulceration is, as a rule, sufficiently easy. Difficulty can scarcely arise, except in the comparatively rare cases in which there is exuberant warty growth before obvious ulceration.

TREATMENT.—The only treatment worthy of consideration consists in amputation of the penis, well behind the point to which the disease has extended. If the inguinal glands have become infected, they should be removed at the same time, if practicable. If they are affected to such an extent as to render their removal impracticable, amputation of the penis can do little, if any, lasting good. Sarcomatous growths may sometimes be successfully removed with their immediate surroundings, without amputation of the whole organ, as has been done in two cases by the writer.

11. **Penis, Elephantiasis of.**—Elephantiasis of the penis is almost always associated with elephantiasis of the scrotum, and may demand simultaneous treatment by operation. *See* ELEPHANTIASIS ARABUM.

ARTHUR E. DURHAM.

PENTASTOMA DENTICULATUM.—The larval form of this arachnid occasionally inhabits the liver; it has been found in the spleen, lung, intestine, and kidney. Its body is 4 to 5 mm. long, and 1·5 mm. broad; it possesses about nine segments, with spiny margins. The mouth is surrounded by four hooks, with chitinous sheaths. Remnants of the larva, usually hooklets, are occasionally found *post mortem*, embedded in cretaceous nodules the size of peas. This parasite has no clinical significance.

J. BLAND SUTTON.

PEPTIC GLANDS, Diseases of.—*See* STOMACH, Diseases of.

PEPTONISED FOOD.—This term may be used as the equivalent of the phrase 'artificially digested food.' In natural digestion albuminoid substances are changed into peptones, and starchy matters into dextrine and sugar. These processes are of a purely chemical nature, and they can be imitated outside the body very closely by means of artificially prepared digestive juices. An extract of the stomach, or of the pancreas, in water, has approximatively the same powers as the natural secretions of those organs. Hence it is possible for us to subject articles of food beforehand to complete or partial digestion; and to administer such artificially digested food to our patients. In cases where the natural digestive powers are more or less in abeyance, it would be an obvious advantage if we had at command a supply of food thus modified, and yet not so changed as to have lost its agreeable appearance and flavour. Nor is there anything repugnant to physiological science or to the custom of mankind in such a proposal. The essential acts of digestion are not vital operations, but chemical transmutations; and the theatre of these operations is on the surface of the gastric and intestinal membrane, and not in the true interior of the body. In the practice of cooking we have, as it were, a foreshadowing of the art of artificial digestion; and although the latter art may never pass beyond the needs of the sick and debilitated—may never serve the healthy and robust—it is not more absolutely alien from the life of animals in a state of nature than is the art of cooking. The practice of cooking is an exclusively human practice, and it is now spread among all the races of mankind, whether civilised or uncivilised; and among the higher races the two most important groups of alimentary substances—albuminoid and starchy matters—are eaten almost exclusively in the cooked condition.

Now the changes impressed on articles of food by cooking are not merely mechanical; nor are they confined to alterations in the appearance and savour of the food. By far the most important changes produced by cooking consist of certain chemical transformations, whereby several of the chief alimentary principles are rendered incomparably more amenable to the action of the digestive juices than in the uncooked state. In a sense we may speak of cooked food as food which has undergone the preliminary stage of digestion. This preliminary stage is accomplished for us of the human race by the artificial aid of heat; but in the case of all the lower animals it has to be accomplished by the labour of their own digestive organs. The affinity of digestion to the process of cooking goes even much beyond this. It has been shown experimentally that albumen, when subjected to the prolonged action of superheated steam, yields a substance resembling peptone, and that starch when similarly treated yields dextrine and sugar. So that it would not be inappropriate to describe digestion as the process of cooking carried a step further.

Methods of Preparation.—Peptonised or artificially digested food may be prepared, either by following the gastric method with pepsin and hydrochloric acid, or by following the intestinal method, and using extract of pancreas. The latter method yields by far the better results. The pancreas acts not only upon albuminous substances, but also upon starch. Pepsin, on the other hand, is quite inert in regard to starch. Moreover, the products of artificial digestion with pepsin and acid are much less agreeable to the taste and smell than those produced by pancreatic extract. By the latter method articles of food can be profoundly peptonised with little deterioration of that agreeable savour which makes them inviting to the palate. The writer will, therefore, in what follows, confine himself to the pancreatic method, and describe the modes in which food may be partially digested beforehand, and yet constitute an acceptable nourishment for invalids.

The first necessity is to procure an active extract of the pancreas. Water is the proper solvent of the digestive ferments; but, in order to obtain a stable preparation, some preservative agent must be added to prevent decomposition. After a trial of various media the writer has come to the conclusion that, on the whole, the best solvent is dilute spirit. A mixture of one part of rectified spirit with three parts of water answers every purpose. The pancreas of the pig yields the most active preparation; but the pancreas of the ox or the sheep may be employed, if that of the pig is not obtainable. The pancreas of the calf also yields an extract which is active on

albuminous substances, but it is not active on starchy materials. In procuring a supply of pancreas from the butcher, it is well to remember that the word 'sweetbread,' which is the English vernacular for pancreas, is likewise applied to the thymus gland; and that the genuine sweetbread of the kitchen is the thymus of the calf. Butchers distinguish the true pancreas as the 'liver sweetbread,' and it is by this name alone that the pancreas must be asked for in the shambles.

Mode of Preparation of Extract of Pancreas or Liquor Pancreaticus.—The pancreas is first well freed from fat, and cut up into small pieces with a knife or a pair of scissors. It is then mixed with four times its weight of the dilute spirit, put into a well-corked wide-mouthed bottle, and set aside for a week. The mixture should be well agitated at least once daily. At the end of a week the mixture is strained through muslin, and then filtered through paper until it is clear.

A very active extract of pancreas is now prepared on the large scale by Mr. Benger, under the name of *Liquor Pancreaticus*, and sent out by Mottershead & Co., chemists, Manchester. As it is a troublesome matter to get a supply of pancreas from the butcher, and as the filtration of the product is a tedious process, it will be found much more convenient to employ Mr. Benger's preparation, if it can be procured, than to rely on home manufacture. In the succeeding instructions for the preparation of peptonised food it will, therefore, be supposed that a supply of Benger's liquor pancreaticus is available.

Directions for the Preparation of Various Kinds of Peptonised Food.—The articles which are most easily prepared, and are most likely to be serviceable to invalids, are the following:—

Peptonised Milk.—A pint of milk is diluted with a quarter of a pint of water, and heated to a temperature of about 140° F. Should no thermometer be at hand, the diluted milk may be divided into two equal portions, one of which is heated to the boiling-point and added to the cold portion, when the mixture will be of the required temperature. Two teaspoonfuls of the liquor pancreaticus and ten grains of bicarbonate of sodium are then added to the warm milk. The mixture is poured into a covered jug, and the jug is placed in a warm situation under a 'cosey,' in order to keep up the heat. At the end of an hour, or an hour and a half, the product is boiled for two or three minutes. It can then be used like ordinary milk.

The object of diluting the milk is to prevent the curdling which would otherwise occur, and greatly delay the peptonising process. The addition of bicarbonate of sodium prevents coagulation during the final boiling, and also hastens the process. The purpose of the final boiling is to put a stop to the ferment-action when this has reached the desired degree, and thereby to prevent certain ulterior changes which would render the product less palatable. The degree to which the peptonising change has advanced is best judged of by the development of a peculiar bitter flavour, which is always associated with the artificial digestion of milk. The point aimed at is to carry the change so far that the bitter flavour is just perceived, but is not unpleasantly pronounced. As it is impossible to obtain pancreatic extract of absolutely constant strength, the directions as to the quantity to be added must be understood with a certain latitude. The extent of the peptonising action can be regulated, either by increasing or diminishing the dose of the liquor pancreaticus, or by increasing or diminishing the time during which it is allowed to operate. By skimming the milk beforehand, and restoring the cream after the final boiling, the product is rendered more palatable.

Peptonised Gruel.—Gruel may be prepared from any of the numerous farinaceous articles in common use—wheaten flour, oatmeal, arrowroot, sago, pearl-barley, pea or lentil flour. The gruel should be well boiled, and made thick and strong. It is then poured into a covered jug, and allowed to cool until it becomes lukewarm. Liquor pancreaticus is then added, in the proportion of a dessert-spoonful to the pint of gruel, and the jug is kept warm under a 'cosey' as before. At the end of a couple of hours the product is boiled, and strained. The action of pancreatic extract on gruel is twofold—the starch of the meal is converted into dextrine and sugar, and the albuminoid matters are peptonised. The conversion of the starch causes the gruel, however thick it may have been at starting, to become quite thin and watery. The bitter flavour does not appear to be developed in the pancreatic digestion of vegetable proteids, and peptonised gruels are quite devoid of any unpleasant taste. It is difficult to say to what extent the proteids of the meal are peptonised in this process. The product gives an abundant reaction of peptone; but there is a considerable residuum of undissolved material. Most of this, no doubt, consists of insoluble ligneous tissue, but it also contains some unliberated starchy and albuminous matter. Peptonised gruel is not generally, by itself, an acceptable food for invalids, but in conjunction with peptonised milk (peptonised milk-gruel), or as a basis for peptonised soups, jellies, and blanc-manges, it is likely to prove valuable.

Peptonised Milk-gruel.—This is the preparation of which the writer has had the most experience in the treatment of the sick, and with which he has obtained the most satisfactory results. It may be regarded as an artificially digested bread-and-milk, and as forming by itself a complete and highly

nutritious food for weak digestions. It is very readily made, and does not require the use of the thermometer. First, a thick gruel is made from any of the farinaceous articles above mentioned. The gruel, while still boiling hot, is added to an equal quantity of cold milk. The mixture will have a temperature of about 125° F. To each pint of this mixture two or three teaspoonfuls of liquor pancreaticus, and ten grains of bicarbonate of sodium, are added. It is kept warm in a covered jug under a 'cosey' for an hour or hour and half, and then boiled for two or three minutes, and strained. If the product has too much bitter flavour, a smaller quantity of the liquor pancreaticus must be used in the next operation. Invalids take this compound, as a rule, if not with relish, at least without any objection.

Peptonised Soups, Jellies, and Blanc-manges.—The writer has sought to give variety to peptonised dishes by preparing soups, jellies, and blanc-manges containing peptonised aliment. Soups may be prepared in two ways. The first way is to add what cooks call 'stock' to an equal quantity of peptonised gruel or peptonised milk-gruel. A second and better way is to use peptonised gruel, which is quite thin and watery, instead of simple water, for the purpose of extracting the soluble matters of shins of beef and other materials employed in the preparation of soups. Jellies may be prepared by simply adding the due quantity of gelatine or isinglass to hot peptonised gruel, and flavouring the mixture according to taste. Blanc-manges may be made by treating peptonised milk in a similar way, and then adding cream. In preparing all these dishes it is absolutely necessary to complete the operation of peptonising the gruel or the milk, even to the final boiling, before adding the stiffening ingredient. For if pancreatic extract be allowed to act on the gelatine, the gelatine itself undergoes a process of digestion, and its power of setting on cooling is thereby utterly abolished.

Peptonised Beef-tea.—A pound of finely minced lean beef is mixed with a pint of water, and ten grains of bicarbonate of sodium are added thereto. The mixture is then simmered for an hour and a half in a covered saucepan. The resulting beef-tea is decanted off into a covered jug. The undissolved beef-residue is then beaten up with a spoon into a paste, and added to the beef-tea in the covered jug. When the mixture has cooled down to about 140° F. (or when it is cool enough to be tolerated in the mouth), a table-spoonful of the liquor pancreaticus is added, and the whole well stirred together. The covered jug is then kept warm under a 'cosey' for two hours, and agitated occasionally. At the end of this time, the contents of the jug are boiled briskly for two or three minutes, and finally strained. The product is then ready for use. Beef-tea prepared in this way is rich in peptone. It contains about 4 per cent. of organic residue, of which more than three-fourths consist of peptone; so that its nutritive value in regard to nitrogenised materials is nearly equivalent to that of milk. When seasoned with salt it is scarcely, if at all, distinguishable in taste from ordinary beef-tea.

Peptonised Enemata.—Pancreatic extract is peculiarly adapted for administration with nutritive enemata. The enema may be prepared in the usual way with a mixture of milk and gruel, or milk, gruel, and beef-tea. A dessert-spoonful of liquor pancreaticus is added to it just before administration. In the warm temperature of the bowel the pancreatic ferments find a favourable medium for their action on the nutritive ingredients with which they are mixed; and there is no acid secretion (as in the stomach) to interfere with the progress and completion of the digestive transformation. Experience has satisfied the writer that this method of administering nutriment is a valuable resource when the stomach is obstinately intolerant of food, or when there is obstruction in the higher portions of the digestive tract.

Uses of Peptonised Food.—The employment of food which has been wholly or partially peptonised is indicated when the natural digestive powers are from any cause enfeebled or suspended. The most striking benefits have been observed in cases of gastric catarrh with pain and intolerance of food; in gastric ulcer; in the anorexia and dyspepsia associated with valvular heart-disease; and in the various forms of pyloric and intestinal obstruction. Good results have also been obtained in cases of defective nutrition and intestinal irritation in infants. In using peptonised food it is well to remember that it does not keep well, especially in warm weather. Accordingly it should either be prepared twice a day, so that it may be never more than twelve hours old; or, if a quantity sufficient for the twenty-four be prepared at once, the portion which remains over at the end of twelve hours should be re-boiled.

WILLIAM ROBERTS.

PEPTONURIA.—A condition in which the urine contains peptones. *See* ALBUMOSURIA.

PERCUSSION (*percusso*, I strike).—A method of physical examination, performed by striking gently some part of the body, especially the chest or abdomen, for the purpose of producing certain sounds or tactile sensations. It may be performed either by the finger or fingers of one hand striking the surface directly, or indirectly—the fingers of the other hand being interposed; or by means of a special instrument or instruments. *See* PHYSICAL EXAMINATION.

PERFORATIONS AND RUPTURES.—It will be convenient to discuss these lesions together, but only from a general point of view, the more important perforations and ruptures connected with particular organs being treated of in their appropriate articles. The word *rupture* is used here in its true significance, and not in the popular sense as applied to hernia. *See* RUPTURE.

DEFINITION.—Though there is no absolute distinction between *perforations* and *ruptures*, there are certain differences by which they are usually broadly recognised.

The term *perforation* is generally applied only to an artificial opening produced in a hollow organ or tube; seldom, and only under special circumstances, to a lesion affecting a solid tissue. Moreover, it implies that the opening is a small one, or, at any rate, does not reach large dimensions. Again, the mode in which the lesion is produced has, in some instances, to do with the definition of a perforation. Thus, if the opening results from injury by a pointed instrument, or by any other agent which would cause more or less of a puncture, such as a fractured rib penetrating the lung, it would be called a perforation, and in this case the term would apply also to a solid organ or tissue. Finally, the slow destruction of certain structures by aneurysms and other tumours often terminates in an aperture being formed, which is then called a perforation. This is well exemplified by the opening formed in the sternum in some cases of aortic aneurysm.

A *rupture* may be associated with any structure, and often involves solid organs, as the liver, as well as firm tissues, such as muscles. It implies a lesion of some size, which may reach any dimensions, being more of a tear or rent than a puncture. There is also associated with the term the idea of spontaneous production, or of the lesion originating from within, or from the effects of some compressing, distending, or lacerating injury, rather than a penetrating one.

ÆTIOLOGY AND PATHOLOGY.—The causes of perforations and ruptures, and the pathological conditions under which these lesions occur, may be thus summarised:—

1. *Injury.*—This often comes from without, and may then be of different kinds. The forms of injury most requisite to notice are perforating wounds; severe compression of the body, as between railway-buffers, which may cause extensive rupture, even of solid organs, without any external mark of violence; violent concussion, as in the case of the brain; and straining, which is especially liable to cause rupture of muscles or arteries. To this category of injuries also belong various causes of perforation or rupture acting from within, such as corrosive agents which have been swallowed, bones and other foreign bodies similarly introduced, calculi, hardened fæces in the intestines, and worms. Cases have now and then occurred in which important internal organs have been penetrated in the attempt made by showmen to swallow swords and other instruments. Similar lesions might possibly be produced also in connexion with surgical operations. 2. *Violent actions.*—Voluntary muscles have by their own excessive action led to their rupture, as in cases of tetanus. The uterus has been known thus to rupture itself. In rare instances the healthy lung has given way from violent cough. 3. *Destructive and degenerative processes.*—These are important causes of perforations and ruptures of various kinds, and they include ulceration or gangrene, as of the stomach or intestine; suppuration, leading to the formation of an abscess, either associated or not with an organ, and which may burst into various internal parts, or externally; cancer; acute fatty degeneration and softening of organs; and chronic fatty, atheromatous, or calcareous degeneration. Some of the conditions mentioned are in themselves essentially destructive; others produce such changes that they render a rupture liable to occur from very little extra force or pressure, such as that which arises from a slight strain, a cough, or the act of vomiting or defæcation, as is well exemplified by the heart and arteries. Even in the case of the destructive processes, some exciting cause may lead to the actual perforation or rupture, such as one of the acts mentioned above, or, in the case of the alimentary canal, the injudicious administration of solid food, or of articles which give rise to flatulent distension. Moreover, after ulceration a cicatrix may be left, which for a time is very liable to give way from slight causes, as sometimes happens in connexion with typhoid fever. The appendix vermiformis is an important structure which has to be borne in mind as liable to perforation from destructive processes. The perforation of the lung which sometimes happens in cases of phthisis is a good illustration of the effects of changes of this kind. 4. *Gaseous and liquid accumulations.*—These may alone lead to rupture of hollow organs or tubes, of the walls of cavities, or of cysts, by causing extreme distension, as may be exemplified by the occasional rupture of the intestines from over-distension, of an emphysematous lung, of the bladder from an accumulation of urine, of the renal pelvis in cases of hydronephrosis, of a distended gall-bladder, of a pleuritic effusion, of a hydatid, pancreatic, or ovarian cyst, or of an aneurysm. Some slight strain or injury may be the immediate cause of the lesion in several of these conditions. 5. *Pressure.*—A tumour of any kind may cause perforation of various structures, as the result of its mechanical pressure. In the case of an aneurysm the pulsation assists

in producing the lesion. In this way the most resisting tissues may be destroyed in course of time, and serious consequences are liable to ensue. 6. *Spontaneous.*—In the case of muscular tissues and arterial structures spontaneous ruptures are supposed to happen occasionally, but probably in all such cases there has been previous degeneration, which may be regarded as the real cause of the rupture.

Anatomical Characters.—It must suffice to mention here, in a general way, that the morbid appearances consist of those presented by the perforation or rupture itself; and of the effects resulting therefrom. The former vary much in extent and character in different cases, and no comprehensive description can be given of them. As regards the effects produced, there may be none, but very commonly hæmorrhage takes place; or the contents of a hollow viscus, or of a fluid collection, may accumulate in some abnormal situation, and these usually set up inflammation, should the patient live long enough, the results of which will be evident on *post-mortem* examination. In the case of slow perforation of structures by tumours, various effects may be produced, of an irritative or destructive character. Particulars on these points are given in other appropriate articles. In the case of the lung, perforation is likely to lead to the escape of air into the pleura or cellular tissue, thus giving rise to pneumothorax or subcutaneous emphysema. On the other hand, liquid accumulations may open into the lung, and thus be found in the air-passages, or they may produce more or less serious effects upon the pulmonary tissues.

Symptoms.—It is not intended here to describe the symptoms which occur in connexion with traumatic injuries, but merely to point out those likely to be noticed in different cases which come under observation in medical practice. Under certain circumstances a perforation or rupture may take place without any obvious symptoms, even when it affects an important structure. This may happen, for instance, even when an opening forms in a hollow viscus, such as the stomach or intestine, provided it has become previously adherent to some solid organ, or to another part of the bowel, with which it then forms a communication. On the other hand, very speedy or even sudden death may ensue, as when a large aneurysm or the heart ruptures. The symptoms to be anticipated are those due to the actual lesion itself, and those resulting from the consequences mentioned under the anatomical characters. As regards the lesion itself, if it is suddenly produced, the event is usually attended with immediate marked symptoms. Of these, one of the most common is a sudden pain at the seat of mischief, often very intense, but varying in its characters. When a muscle ruptures, a feeling is frequently experienced as if a severe blow had been struck, and power is lost at once in the affected part. This is well exemplified in cases of rupture of the gastrocnemius, an accident which is not uncommon in connexion with the game of lawn tennis. When a hollow viscus or any fluid collection bursts, or when gas escapes, a sensation as if something were being poured out is often noticed by the patient. At the same time the general system usually suffers more or less gravely, as evidenced by faintness or actual fainting, or by signs of shock or collapse, from which the patient may never rally, if the structure involved is of great importance in the vital economy, or if continuous hæmorrhage should be going on. The symptoms above indicated may be repeated if the lesion should extend after an interval. It may be mentioned that when rupture of an abdominal organ takes place from severe compression of the body, there may be no symptoms of the event at the outset, and only the development of grave collapse indicates what has happened. The occurrence of hæmorrhage into internal parts, or the escape of the contents of the viscera or of a fluid accumulation, may be obvious on physical examination. Should the patient survive in cases of rupture into internal parts, local and general symptoms pointing to the occurrence of inflammation may be expected to supervene. For instance, in the case of the abdomen there would be signs of peritonitis, or of localised inflammation in some part of the cellular tissue, probably ending in suppuration. In perforation of the lung, symptoms and physical signs of pneumothorax appear, or subcutaneous emphysema may become evident in exceptional cases. When an opening is formed between some collection of fluid and any organ or channel which communicates externally, such as the air-passages or the alimentary canal, such fluid is likely to be discharged in different ways, and this may be a favourable mode of termination, leading to a cure. In the case of slow perforation by a tumour, should it take place in an outward direction, the lesion will probably become evident on clinical examination; if internal structures are affected, the process of destruction may be accompanied with continuous pain or other symptoms; and subsequently clinical phenomena indicative of implication of various structures arise, either suddenly or gradually. For example, when an aneurysm or solid growth destroys any part of the spinal column, this is attended with a continuous aching or grinding pain; and when the canal is perforated, symptoms arise indicating that the spinal cord is involved.

Diagnosis.—It is scarcely practicable to offer any useful general remarks under this heading, and it must suffice to notice the

following points. The difficulty of diagnosis varies much in different cases, being sometimes very easy, in other instances more or less obscure or impossible. The practitioner should always be prepared for the possibility of cases of sudden perforation or rupture of internal structures coming under his notice, of which he may have no previous knowledge. Under such circumstances a careful inquiry into the previous history may reveal the presence of symptoms of known conditions, likely to lead to such lesions, which would clear up any obscurity; but there is often no such history. There ought to be no difficulty, as a rule, if the damage occurs from some recognised cause, such as certain kinds of injury; or if it supervenes in some case under the care of the practitioner for a disease liable to be attended with perforation or rupture of some part, such as typhoid fever, gastric ulcer, an internal abscess, or an aneurysm. In the case of slow perforation, it is very important to be able to recognise the meaning of symptoms which may supervene from this cause.

Prognosis.—Any rupture or perforation taking place internally must always be regarded as immediately more or less dangerous to life, and not uncommonly the termination is necessarily fatal. Much will depend on the structure involved, the extent of the lesion, and its direct and remote consequences. Caution must in every case be exercised in giving a prognosis, for some patients recover when such a result might not be anticipated; and especial care must be taken in offering an opinion should the diagnosis not be quite clear. In the case of ruptures or perforation taking place externally, or affecting structures not essential to life, such as the muscles of a limb, the prognosis of each case must be determined on its own merits.

Treatment.—In the case of sudden internal perforations or ruptures, the first principle in treatment should be to counteract the immediate effects of the lesion, alleviating pain, while at the same time rousing and stimulating the patient by appropriate remedies. Opium or morphine and alcoholic stimulants are of great service, and they may often be advantageously introduced into the system by means of enemata, or, in the case of morphine, by subcutaneous injection. Heat to the extremities, sinapisms, and similar applications are also frequently of much value. The patient should be kept quiet; and it may also be of essential importance to endeavour to keep an organ which has been perforated, such as tho stomach or intestines, in an absolute stato of rest, by withdrawing all food, and checking peristaltic movements by opium or other agents. The same principlo applies to somo parts of tho body, such as a limb, if a muscle or a vessel have been ruptured; and here tho position of the limb is often of much consequence. Other appropriate measures will suggest themselves in different cases. Some special interference may be indicated. For instance, it might be clearly allowable to open the abdomen in certain cases; to strap or puncture the chest to relieve pneumothorax; or to cut down and tie a ruptured artery. Hæmorrhage resulting from a lesion of this kind in internal parts may sometimes be checked by the constant application of ice externally, over the corresponding part of the body. The subsequent treatment of cases of rupture or perforation must be determined by the effects that they produce, which must be dealt with according to their nature, each case being considered on its own merits. The same remark applies to cases of gradual perforation by tumours and other morbid processes. Frederick T. Roberts.

PERICÆCAL ABSCESS.—An abscess in the cellular tissue around the cæcum. *See* Perityphlitis.

PERICARDIUM, Diseases of.—Synon.: Fr. *Maladies du Péricarde*; Ger. *Krankheiten des Herzbeutels.*

The pericardium proper is a membranous bag, one part of which—the visceral layer—closely envelops the heart and the roots of the great vessels connected with it; while the other—the parietal layer—is loosely reflected round that organ, and has its external surface intimately united with a dense fibrous sheath which passes upwards, and is gradually lost upon the external coats of the vessels, whilst it is continuous below with the central aponeurosis of the diaphragm. A serous fluid bedews the interior of this sac, and facilitates the movements of the heart, so that both in structure and function the pericardium may be regarded as a joint—somewhat modified, no doubt, to suit its internal position, as well as the nature of the parts with which it is connected.

The morbid conditions of the pericardium will be discussed in the following order: (1) Dropsy; (2) Inflammation; (3) Gas in the Pericardium; (4) Malformations; (5) New-Growths; and (6) Pericardial Adhesions.

We may first, however, refer to a condition of tho pericardium which can hardly be described as pathological, consisting of slight opacitios, which are termed *milk-spots.* Theso are froquently observed upon the pericardium after death, but they give riso to no clinical symptoms, and are merely to be regarded as callosities duo to attrition. The most common situation is at the base of tho right ventricle in front, but they are also found on tho apex, and are occasionally seen as white stripes upon tho auricles, and along tho course of the coronary arteries. Such *maculæ albidæ* are most common on large, strong, and hypertrophied hearts, but they

are not altogether confined to these. When due solely to attrition, these spots are formed by a mere thickening or condensation of the normal tissue; but now and then they are found to consist of a thin layer of fibrinous matter which may be peeled off, leaving the pericardium beneath opaque, but otherwise natural. In the latter case, of course, these spots cannot be regarded as simple callosities, but as the results of some trifling local pericarditis, running its course without symptoms and of no clinical importance, except as affording a probable explanation of those temporary basic frictions which are occasionally to be heard in those otherwise in apparently good health, so far at least as the heart is concerned.

1. **Pericardium, Dropsy of.**—Synon.: Hydropericardium; Fr. *Hydropéricarde*; *Herzbeutelwassersucht.*

During life and in health the serosity bedewing the internal surface of the pericardial sac exists in an appreciable quantity, so that an ounce or two of fluid found in it after death is not to be regarded as anything abnormal. When, however, the fluid present amounts to as much as five or six ounces, or more, the condition is morbid, and is termed *hydropericardium*, or dropsy of the pericardium. The contained fluid is a yellowish, greenish, reddish, or reddish-brown serosity, containing from 1 to 3 per cent. of albumen, and occasionally a trifling amount of fibrinous matter, which coagulates on simple exposure to the air—*hydrops lymphaticum* (Virchow, *Gesammelte Abhandlungen*, p. 108). The colour of the fluid is due to the amount of blood-colouring matter infused through it; and the reddish, or reddish-brown coloration is specially present when from any cause, such as the co-existence of scurvy, the colouring matter is more readily diffused than usual, or in those exceptional cases where the walls of the capillaries are so altered by nutritive changes as to rupture.

All the phenomena present in dropsy of the pericardium are similar to those associated with a corresponding amount of inflammatory effusion, and will be referred to under that head. Hydropericardium is a possible occurrence in all diseases, whenever there is, from physical causes, a tendency to transudation of serum into the cavities of the body. According to the nature of that cause it may be either an early or a late phenomenon, and it frequently only attains any considerable proportion during the act of dying. When dropsy occurs from venous congestion due to disease of the heart, or to disease of the lungs, such as emphysema or cirrhosis, some degree of hydropericardium is not uncommon as an early symptom; but when the dropsy results from hydræmia produced by chronic organic diseases of the spleen, liver, or kidneys, or by the exhaustion due to cancerous or tubercular diseases, the pericardial effusion is usually a late symptom.

Treatment.—The treatment of hydropericardium resolves itself into the treatment of the diseases upon which it depends; and it is only when the fluid becomes suddenly effused, in a quantity so large as to threaten death by suppression of the heart's action, that an independent treatment by paracentesis may be found necessary. Such sudden effusion occasionally, but only very rarely, takes place in the course of the acute albuminuria following scarlatina, or even in the more chronic albuminuria, the result of intratubular nephritis.

2. **Pericardium, Inflammation of.**—Synon.: Pericarditis; Fr. *Péricardite*; Ger. *Herzbeutelentzündung.*

Acute inflammation is the most serious, if not the most frequent, affection of the pericardium.

Ætiology.—This disease, though occasionally idiopathic, is much more frequently secondary in its character. So-called idiopathic pericarditis is usually associated with pleurisy, frequently with bilateral pleurisy, and is not uncommonly latent so far as any direct symptoms of pericardial implication are concerned. Secondary pericarditis may be the result of wounds from without or from within—through the œsophagus; of blows and contusions on the præcordial region; of abscesses perforating from the lung, or from the liver—through the diaphragm; of enteric fever, variola, scarlatina, and pyæmia in all its forms; of the spreading by contiguity of the inflammatory process from neighbouring organs, such as the lungs, pleura, or costal periosteum. It may accompany the local development of cancer or tubercle; or may be due to rheumatism, or to one or other of the chronic forms of Bright's disease. By far the larger proportion of cases of pericarditis occur in connexion with the two last-named diseases, in about the ratio of two of rheumatic pericarditis to one of renal pericarditis; all other forms lumped together forming an infinitesimal and incalculable fraction. In rheumatism, pericarditis occurs early; occasionally precedes the joint-affection; and though no period of the disease can be regarded as free from the tendency to this so-called complication, just as any joint may be implicated at any period, yet experience teaches us that the heart-joint is most usually affected within the first week of the rheumatic onset. In renal disease, on the other hand, it is most usually a late phenomenon, being only too frequently the immediate precursor of that fatal uræmia which its occurrence serves to precipitate.

The pathology, symptoms, signs, and treatment of pericarditis, however it may arise, are all very much alike, and may be conveniently treated of together.

ANATOMICAL CHARACTERS. — The morbid anatomy of pericarditis is simple enough. Very early pericarditis is rarely seen except as associated with Bright's disease, and then at first we have merely vascular injection, with a few shreds of lymph visible about the roots of the great vessels. In a few days, in those dry forms of the disease where but little fluid is effused, the whole surface of the heart may be covered with a thin fibrinous layer, which may, even at this early stage, have connected together the visceral and parietal layers of the pericardium somewhat firmly (Wilks). More usually there is some serous exudation mingled with the fibrinous matter, which then is found covering the pericardium in a reticular or honeycomb pattern, which Laennec has likened to the appearance presented on suddenly separating two smooth pieces of wood between which a small pat of butter has been forcibly compressed. The serous effusion may occasionally amount to several pints; it is always turbid from the molecular fibrin suspended in it; and is of a yellowish, greenish, brownish, or reddish colour. When along with any considerable layer of lymph upon the pericardiac surfaces, there is much fluid effused, the surface of the lymph is covered with shaggy processes floating in the fluid, these processes sometimes presenting a mammillated appearance. In a very short time a fine network of capillaries is developed in the fibrinous exudation; and the rupture of these newly developed capillaries now and then gives rise to what is termed 'hæmorrhagic pericarditis,' in which the fluid, and even the solid lymph, is deeply stained with the blood-colouring matter. This also happens when pericarditis is associated with purpura or scurvy; and now and then, from similar causes, layers of coagulated blood are found alternating with layers of unstained lymph.

When the disease does not prove fatal, the exudation may be entirely re-absorbed, or it may become organised, or other changes may occur. First of all, the excess of fluid and the molecular fibrin become absorbed; then the coagulated fibrin may become worn away by the continual play of the heart, and gradually entirely absorbed; and a complete cure may be thus effected, leaving at the most only a slight thickening or opacity of the pericardium. But such a cure is only possible when the amount of exudation has been inconsiderable. More usually, connective tissue is gradually developed in the fibrinous layers; either locally, giving rise to partial adhesions, which about the base of the heart are more dense, but at the apex are often drawn out to fibrous strings; or the two layers of the pericardium may be so closely united that they can only be separated with considerable force, and now and then, after the lapse of some time, they cannot be separated at all, the cardiac muscle being torn in the endeavour. Occasionally pus, or the cheesy or calcareous remains of such a deposit, may be found, encysted, as it were, between the adhering layers of the pericardium; and it sometimes happens that this calcareous layer envelops the whole heart, which then seems to be converted into bone. Laennec, Louis, Allan Burns, and others relate cases of this kind, and the heart described by Burns is still preserved in the anatomical museum of the Edinburgh University. In every fibrinous exudation within the pericardium there is at a particular stage a certain amount of all those elements present which may become pus, and these give rise to a milky opacity of the fluid, or, if present in sufficient number, may metamorphose the whole exudation into pure pus. This may be only a transition stage; the pus-cells may break down, a pathological cream may be formed, and the whole may be ultimately entirely absorbed. But true purulent pericarditis, though a rare occurrence under any circumstances, is most frequently fatal, and seems to occur chiefly in connexion with serious general disease, or to accompany the rupture of local abscesses, pulmonary or hepatic, into the pericardium. What has been termed an 'ichorous exudation' in the pericardium, is simply a putrefaction of that already existing, which becomes brownish in colour and stinking. It may arise from entrance of the air into the pericardium after paracentesis conducted without antiseptic precautions; but it is also believed that such putrefaction may arise in patients greatly enfeebled by exhausting diseases, such as cancer, without any entrance of air into the pericardium. An exudation that has become ichorous may corrode the pericardium; is incapable of further metamorphosis; and is usually speedily fatal by the development of pneumo-pericardium. *See* 3. Pericardium, Gas in.

SYMPTOMS.—The symptoms of pericarditis are of comparatively little importance, because they are frequently entirely absent in those so-called idiopathic forms of the disease which are probably always fatal, as well as in renal pericarditis, which is fatal in the majority of cases; whilst even in rheumatic pericarditis, in which the mortality is at the most only about 16 per cent., and is *nil* according to some authors (Bamberger, &c.), the symptoms, though rarely absent, are generally not very well marked or distinctive. As a rule, if pericarditis be associated with any other serious disease, such as pneumonia, pleurisy, or rheumatism, the symptoms are apt to be swamped by those of the primary disease. In other instances, the advent of the pericarditis is indicated by a rigor, a rise of temperature, a feeling of anxiety and oppression at the chest, and the occurrence or increase of dyspnœa. The decubitus is usually dorsal, and syncope is liable to be

induced on raising the patient. There is pain in the cardiac region, with palpitation of the heart. The pulse is at first full and frequent, always compressible, frequently irregular, usually dicrotic, and rapidly becomes feeble; and there is a general exacerbation of all the symptoms of the already existing disease. Occasionally the restlessness and anxiety indicative of cardiac implication pass into delirium, which may be low and muttering, wild and maniacal, possibly accompanied by delusions, and which may be associated with tetanic or clonic spasms, or with convulsions ending in extreme exhaustion, or in death by coma. The occurrence of delirium in the course of rheumatic fever ought at once to direct attention to the heart; and the sudden occurrence of spasms or coma in chronic renal disease is only too frequently found to be associated with pericarditis; both of these phenomena being probably caused by the saturation of the blood with the products of retrograde metamorphosis, due to the sudden development of this inflammation. It is only in the very rarest instances that we have that extreme oppression of the chest, violent pain in the cardiac region, hiccough, fainting, and livid countenance, coupled with delirium, and extremely rapid dicrotic pulse, which constitute the classical portrait of pericarditis; and even in those rare cases in which these symptoms are observed, they are rather due to the association of pericarditis with an already existing serious disease, than to the pericarditis itself. In most cases physical examination gives us the first intimation, and in all cases the only reliable information, as to the existence of pericarditis. In all diseases, therefore, in which pericarditis is a possible occurrence, we must carefully examine the cardiac region from day to day, or more often, that we may at once ascertain its occurrence; while at all times, the slightest pain in the chest, or most trifling oppression of breathing, ought to be a sufficient warrant for a most careful physical examination of the chest, because men have been known to go about their ordinary duties —with difficulty, no doubt—even while pericarditis existed.

Physical signs.—Whenever on auscultating over the cardiac area we hear a friction-sound, we are justified in assuming the probable existence of pericarditis. And the probability of this surmise is increased just in proportion as we can eliminate all sources of fallacy, and associate it with those symptoms already described as indicative of pericarditis, and with the other signs presently to be described as having the same significance. A friction-sound due to pericardial roughness may be heard over any or every part of the cardiac area, in front or behind. Its most usual position is over the base of the heart in front, and once heard in that position no amount of subsequent effusion suffices to efface it. The sound of such a friction appears superficial, close to the ear; it may resemble only a slight sound of rubbing, the crackling of paper or parchment, or the creaking of new leather; or at times it may simulate so closely the blowing sound of a valvular murmur as to be indistinguishable from such a murmur by the sound alone. Occasionally a friction-sound is persistently absent throughout the whole course of the disease, and that even where there is abundance of fibrin effused. It is difficult to account for this. Some suppose it to be due to mere softness of the fibrin; more probably feebleness of the heart's action has a good deal to do with it, as well as some alteration of the parts—especially the lungs—overlying the heart, which may render them bad conductors of sound.

Friction-fremitus may occasionally be detected by the hand placed over the præcordia, but this is not always to be felt. Apart from fremitus, within the first few days of the onset of the disease, we perceive by palpation an unusually forcible and turbulent action of the heart, which is also occasionally irregular, and is due to inflammatory irritation of the cardiac muscle. By-and-by, as the inflammation progresses, cardiac debility sets in, and the pulsation becomes less forcible, while in most cases it is still further obscured by the occurrence of fluid effusion, which separates the apex from the anterior wall, with which the base of the heart always remains in contact. In this way we have produced that phenomenon which is termed 'displacement upwards of the apex-beat,' because the more the true apex is pushed inwards by the effusion, the part of the heart actually in contact with the chest-wall approaches more closely the base of the ventricles. Should the heart be greatly hypertrophied, its impulse may remain distinct throughout the whole course of the disease, the fluid accumulating behind it and not in front.

So long as the serous accumulation is inconsiderable, there is no alteration of the percussion-sound; but whenever this attains an abnormal amount, it is revealed by an increase of the cardiac dulness; and in the ordinary dorsal decubitus of the patient this is first observed at the base, in the line of transverse dulness along the level of the fourth rib. By-and-by, however, the ordinary pyramidal dulness of the heart, base upwards, becomes reversed, and we have a pyramidal dulness with the base below and the apex upwards; and this apex may rise as high as the clavicle, or even above it. The base, on the other hand, may in these cases extend beyond the ordinary position of the apex-beat to the left, especially if the patient be made to lie upon his left side; but it is mobile, and on turning the patient on his right side the dulness leaves the left and passes towards the right. Very great

emphysema of the lungs may obscure this dulness, but cannot altogether annihilate it; but of course this method of diagnosing pericardiac effusion can only be put in force when both pleuræ are free from fluid. The fluid effusion, even when confined to the pericardium, may amount to several pints, and its pressure may not only embarrass the heart's action, but may also so compress the lungs, particularly the left one, as to give rise to considerable dyspnœa; and the hindrance thus presented to the free passage of the blood through the lungs may give rise to considerable systemic venous congestion, which is readily observed in the turgid condition of the jugular veins.

As a rule, inspection gives us little, if any, information in regard to the existence of pericarditis. Should the quantity of fluid effused be very considerable, and the chest-walls flexible, some vaulting of the pericardial region may be observed, due to the effacement of the intercostal spaces, the ribs being occasionally also more widely separated than usual, at least apparently so; and the whole præcordial space under these circumstances takes a less share than ordinary in the respiratory motions. Undulatory movements due to waves of fluid, as described by some, are never seen; such movements, if visible, depend upon the wobbling of an enlarged and feeble heart, and not on any fluid waves.

Diagnosis.—A friction-sound has been hypothetically supposed to be occasionally due to mere dryness of the pericardiac membrane. Possibly this may be the case, but it has never been proved. Even if it be the case, then such dryness, associated with the symptoms described, can only be an early stage of inflammation. Apart from these, it may or may not be an indication of commencing inflammation, and must be watched and treated accordingly. It has also been alleged that calcareous concretions and tubercular and carcinomatous roughnesses may give rise to a friction-sound. Associated with the symptoms described, any friction-sound, even presuming such a possible origin, must be regarded as a form of pericarditis, whilst apart from these symptoms it must still be watched with suspicion. The most difficult cases to diagnosticate are those in which the friction-sound is due to pleurisy alone, and is yet audible during cardiac action, when the respiration is temporarily suspended. This is a rare occurrence, but it does happen, and the diagnosis is almost impossible. The subsequent progress of the case may show that the pleura is certainly affected, but that is no proof that the pericardium is not also implicated; or the pericardium may be assuredly diseased, and yet the friction-sound may be solely due to pleurisy. The general symptoms and the condition of the pulse count for something, but the diagnosis between pleurisy and pericarditis is, in such cases, manifestly a difficult one, only to be solved by the further progress of the case. Now and then we have a friction-sound audible towards one or other side—usually the left—of the pericardium, during suspension of the respiratory movements, the base of the heart being entirely free from friction; and in these circumstances the probability seems greatly in favour of the strictly pleural nature of the disease. But even in such cases a perfectly accurate diagnosis is impossible. There is never any real difficulty in determining between a valvular murmur and a frictional pseudo-murmur, because in the case of the latter the sound is restricted to the cardiac area, and usually only to a small portion of that, not being propagated to any extent out of its position of maximum intensity, and then only equally all round, and not in any of the definite lines in which valvular murmurs are propagated. Moreover, the position of maximum intensity of a frictional pseudo-murmur never coincides with that of any valvular murmur, except occasionally with a diastolic aortic one; while, of course, the natural sounds of the heart are never replaced by the pseudo-murmur, though they may be partially obscured by it, and all the secondary results of the valvular lesion simulated are entirely wanting.

Prognosis.—The prognosis in pericarditis is not unfavourable; one in six, or about 16 per cent., is mentioned by some as the ordinary mortality; but Bamberger makes the questionable assertion that pericarditis associated with rheumatism or other curable disease invariably terminates favourably, though the mortality is always large when it is associated with Bright's disease and other incurable affections, the fatal termination of which is hastened by the pericardiac affection. Pericarditis, like any other acute inflammation occurring in an otherwise healthy individual, may be expected to run a favourable course if not unduly treated; and the danger to life is to be calculated by the seriousness of the co-existing complications, and the age and state of the vital powers of the patient. The unfavourable phenomena are, a large quantity of effusion, great dyspnœa, feeble heart's action, small and irregular pulse, lividity, delirium, and other nervous symptoms.

Treatment.—The treatment of pericarditis must be regulated to some extent by the nature of the disease with which it is concomitant. If it concur with pneumonia or pleurisy, it may safely enough be entrusted to the remedies employed for these diseases; or should it accompany rheumatism, then we must treat it as part of the rheumatic affection. Those who have shown the smallest percentages of deaths have been the least perturbative in their treatment, as we might reasonably expect. A rheumatic pericarditis

ought therefore to be treated simply as part of a rheumatic affection; but inasmuch as pain implicating the heart has a decided tendency to depress its action, it is of the utmost importance to relieve it at once. With this view a large warm poultice should be applied over the heart; and morphine injected subcutaneously, and repeated by the mouth, or subcutaneously, at regular intervals, so as to keep the patient free from pain. Perfect rest must be enjoined. Should there be much dicrotism of the pulse, or any tendency of the heart to fail, then digitalis should be administered at regular intervals, in doses sufficient to keep up the cardiac action, such as ten minims of the tincture every four hours; and with this may be conjoined the use of hydrate of chloral in ten-grain doses, which is not more useful as a sedative than as an antiphlogistic, and which may very well replace the morphine, having the additional recommendation that it does not interfere with the secretions which demand attention, nor promote the sweating so troublesome in rheumatism. Where it may be considered advisable to give an alkali, such as potash or ammonia, with the digitalis, it cannot be combined with the chloral, but must be given separately. In recent times, salicin and the salicylates have been employed with success in the treatment of rheumatism. They do not prevent the occurrence of pericarditis, but their use is not contra-indicated by its presence. Blisters are frequently recommended in pericarditis, but they tend to irritate the patient and to excite his heart's action.[1] We must, in fact, treat the pericarditis as part of the general rheumatic attack, only requiring a little more attention than usual in the way of warmth, and relieving pain; and all the past history of this disease proves that we shall in this way be more likely to promote a favourable termination of the disease, than by jeopardising our patient by dangerous and uncertain medications.

Where the amount of fluid effused is very great, or when the symptoms seem to point to the presence of pus, it may become a question whether paracentesis should be performed or not. The results of this operation hitherto have not been very satisfactory, but that is no reason why it should not be resorted to if it seem necessary, especially as it can nowadays be so easily done by means of one or other of the aspirators. The patient should be placed in the recumbent position, and the needle entered between the fourth and fifth ribs, about half an inch to the left of the sternum, the operation being performed antiseptically, and the fluid drawn off slowly. For this reason we should be careful in our choice of an aspirator, as one having a powerful vacuum might induce syncope, by withdrawing too rapidly from the heart a pressure to which it has become accustomed. A dilated heart has been said to have been punctured, instead of a distended pericardium, but in the present day such a mistake is scarcely possible, though it must be carefully guarded against. It now and then happens that after the acute symptoms pass away, the pericardium remains obstinately distended with fluid, and it is, perhaps, chiefly in these cases that *paracentesis pericardii* presents the most hopeful prospects. *See* PARACENTESIS.

[1] It would be well to mention that in the earlier stage of the disease, and under favourable circumstances, leeches might be applied with marked benefit.—EDITOR.

3. Pericardium, Gas in.—The putrefaction of an exudation has been supposed to cause the development of various gases within the pericardium, and the production of so-called *pneumo-hydro-pericardium.* This, however, seems to be a very doubtful cause of a very rare condition. It is readily recognised by the clear tympanitic percussion-note over the usually dull cardiac area, with a metallic gurgling accompanying the cardiac movement. Pneumo-hydro-pericardium is now generally believed to be caused by the entrance into the pericardium of gases from the stomach and intestines, or of air from the œsophagus or lung, or *ab externo*, through some wound, or from the breaking into the pericardium of pus, or broken-down cancerous masses, affecting some of the neighbouring organs. With the air there enter into the pericardium a multitude of morbific germs. Inflammation is thus started, followed by exudation, generally of a purulent character, but sometimes serous, and in weakly and cachectic individuals possibly bloody—a hæmo-pneumo-pericardium.

4. Pericardium, Malformations of.—These malformations are described in the article HEART, Congenital Misplacements of.

5. Pericardium, New-Growths in.—Both tubercle and cancer may become developed in the fibrinous layers of a pericarditic exudation, as a rule secondarily to the occurrence of these processes in other organs. This is a very rare circumstance, however, as is also the occurrence of tubercular or cancerous nodules of a secondary character in the substance or on the surface of the pericardium itself, with which a secondary pericarditis speedily becomes associated. In either case, but particularly in the former, the fluid in the pericardium is usually of a hæmorrhagic character when associated with the development of cancer. Tubercular, and more frequently cancerous, masses are occasionally formed in the lungs or mediastinum, and pressing upon the pericardium give rise to pericarditis, which reveals itself mainly by the signs of effusion, and without any direct symptoms of cardiac implication. Such cases are not often recognised during life. The prognosis is always fatal; and the treatment palliative only.

6. **Pericardial Adhesions.**—Pathologically speaking, the most important of all the terminations of pericarditis is adhesion of the two layers, which in its most exquisite form was described by the ancients as congenital absence of the pericardium. This is a state of matters impossible to diagnose, though it may be surmised; and too often it escapes even a surmise, unless the previous history of the case be well known. Very rarely there remains a permanent depression over the cardiac area, the result of pre-existing pericarditis, and subsequent adhesion of the visceral and parietal layers and also of the superjacent pleura. More frequently, but still rarely, this state of matters is revealed by a systolic depression of the parts over the cardiac apex. Even more rarely—because the result of a more extensive inflammation—we have a systolic depression over the scrobiculus cordis, caused by adhesion of the two layers of the pericardium to each other and to the pleura covering the diaphragm, and concomitant adhesion of the diaphragm to the liver.[1]

It can be only rarely that extensive pericarditis exists without a simultaneous myocarditis, and the results of the latter affection were formerly too frequently referred to the pericarditis itself. An adherent pericardium occurring in early life may hamper the future growth of the heart, and may thus produce one form of so-called atrophy of the heart, with all the consequent results of impaired nutrition. But it is only when the subpericardiac layer of muscular fibres has been involved in the inflammation, that we may have atheromatous or fibrous changes taking place; and, as the result of these, encasement of the heart in a calcareous wall; a local or, more rarely, a general thin and fibrous condition of the cardiac muscles; and either local aneurysmal or general dilatation. These results are, however, rare. Hypertrophy is not always to be regarded as the result of pericardial adhesion, but of a concomitant lesion which may be present, or of some other cause; for though pericardial adhesion may co-exist with cardiac hypertrophy, it does not necessarily give rise to it. In a large proportion of cases simple pericardial adhesion is to be regarded as not productive of any appreciable results of an untoward kind.

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[1] The diagnosis of adherent pericardium is of great clinical interest. The difficulty which attends the determination of this condition, and which is always greater in stout subjects, partly depends on the circumstance that adhesions may be either partial or complete, either loose and free or firm and of a contractile character; and that the pericardium may or may not have contracted adhesions anteriorly with the different layers of the pleura, and posteriorly with the surrounding parts. In firm and extensive pleuro-pericardial adhesion the physical signs that have been most relied upon are: (1) Well-defined systolic recession in the region of the apex impulse, or within that area and in the epigastrium and lower sternal region; (2) diastolic rebound felt by the hand in the same situations; (3) non-diminution of the superficial præcordial dulness and non-depression of the impulse, but on the contrary depression of the epigastrium, in inspiration; (4) fixation of the impulse in change of cubitus; (5) superficial character of the heart-sounds; (6) presence of dulness and of impulse beyond (that is, to the left of) the seat of maximum impulse; and (7) evidence of cardiac enlargement after acute rheumatism, without evidence of valvular disease.—Editor.

PERIHEPATITIS (περί, around; and ἧπαρ, the liver).—Inflammation of the capsule of the liver. *See* Liver, Inflammation of.

PERINEPHRITIS (περί, around; and νεφρός, the kidney).—Synon.: Fr. *Périnéphrite*; Ger. *Perinephritis*.

Definition.—An acute or chronic disease of the cellular tissue around the kidney, consisting of inflammatory thickening of, and exudation into, the tissue, frequently followed by suppuration; characterised by fever, local pain, fulness, tenderness on pressure, and in many cases ultimately by fluctuation; and resulting frequently in death, sometimes in spontaneous recovery.

Ætiology.—Perinephritis in most cases originates from pyelitis or suppurative nephritis, by perforation or by extension of the inflammatory process. It is especially related to pyelitis from urinary calculus. It may result from injuries, such as blows, wounds, or severe strains; or from extension of inflammation from neighbouring parts, as from the pelvis, the gall-bladder, or the testicle and spermatic cord. The disease appears in some cases to result from exposure to cold, especially after previous exposure to excessive heat. It arises also in the course of or as a sequel to fevers, particularly the exanthemata. It is most common in adults; and appears to affect equally the two sexes.

Anatomical Characters.—In the earlier stages the cellular tissue around the kidney is congested; and when exudation has supervened, the affected tissue becomes solid and firm. Usually suppuration speedily takes place in the centre of the mass, commencing either at one or at numerous points, and gradually extending. The pus is sometimes odourless, sometimes fœtid. It is important to remember that a fæcal odour may be present without perforation from the bowel. The perinephritic abscess may become so large as to extend from the level of the liver and spleen to the iliac fossa, and may project so far forward as to bulge the abdominal wall. The pus may burrow and make its way to the surface at the lumbar region, in the lower part of the abdomen, or even in the thigh. More commonly it makes its way into the ureter, or the colon; sometimes into the peritoneum. Occasionally the diaphragm is perforated, and the pus is discharged

through the lung. Sometimes rapid gangrene is induced, and sloughy masses are found, mingled with the purulent *débris*. Either without going on to suppuration, or after discharge of the pus, cicatrisation may take place, dense fibrous tissue permanently occupying the place of the structures which had been involved.

Symptoms.—The constitutional symptoms in perinephritis are generally well-marked. The attack may be ushered in by rigors recurring frequently, sometimes periodically. The temperature rises to 100° or even to 105°. The pulse becomes rapid, and either bounding or feeble. The tongue is furred; there is great thirst; the appetite is lost; and there is a tendency to constipation, due in part to the fever, in part to the mechanical pressure upon the bowel. The skin is hot and dry; sometimes there are profuse sweatings, particularly during the later stages of the malady. The local symptoms are pain, usually aggravated by movement, and markedly by pressure; and the presence of a tumour. The tumour rapidly increases; and while it is at first hard throughout, it soon presents deep-seated fluctuation, which becomes gradually more distinct and superficial. The skin in the lumbar region is often œdematous, and is usually pale, excepting when perforation is about to take place. The position of the mass is important. It is situated in the region of the kidney, and is inseparable from it, while as a rule separable from the liver and spleen. The urine may be quite natural, but in many cases it is altered, in consequence of the presence of pre-existing pyelitis or nephritis; but even in cases which do not originate in renal disease, there is a tendency to diminution of the urine at first, and this is apt to continue throughout, accompanied by a dark colour of the secretion.

The onset of perinephritis is generally acute, but it may be very insidious, especially when it follows pregnancy. Probably it sometimes terminates by resolution without going on to suppuration. When suppuration is once fairly established, it extends and makes its way, either to the surface or into some internal cavity. When the pus is making its way outwards, there are the usual features of a burrowing abscess—the skin becomes red and prominent, and at last an opening is formed by ulceration. When the pus makes its way into the colon, a copious discharge of pus by the bowel occurs; and, owing to the nature of the opening, fæcal matter seldom makes its way into the abscess-cavity. If bursting occurs into the ureter, evacuation of pus from the bladder takes place. If into the lungs, a sudden discharge may happen with coughing, the layers of the diaphragmatic pleura having been first agglutinated together. With all these modes of termination there are, as a rule, fall of temperature and relief of the general and local symptoms. When the abscess makes its way into the peritoneum, fatal peritonitis is rapidly lighted up. When through the diaphragm, should the two layers of the pleura not be adherent, empyema is produced, with sometimes gangrene of the lung. In some instances of perinephritic abscess there is a fatal termination without perforation having occurred, by means of blood-poisoning, either in the form of pyæmia with secondary abscesses, or of septicæmia with affection of the spleen and other blood-glands. In a few cases suppurative pylephlebitis has been met with, accompanied by secondary abscesses in the liver.

Diagnosis.—The concurrence of fever with pain and swelling in the region of the kidney, is almost distinctive of perinephritis. The tumour is fluctuating, and is in the immediate neighbourhood of the kidney; it is usually confined to one side; its mass may be tilted forward by pressure on the renal region. It must be distinguished from new formations of the kidney, spleen, liver, or mesenteric glands; from hydronephrosis; and from extravasation of blood into the cellular tissue, due to rupture of an aneurysm. From the first group it is distinguished by the fever, and the fluctuation and exact position of the mass; from hydronephrosis by the fever, and the characters of the enlargement; from the aneurysmal extravasation by the comparatively slow growth of the tumour, and the absence of the characters of aneurysm. In most cases certainty is most readily attained by means of the aspirator. Pyonephrosis must be excluded by a careful survey of the history of the case—particularly of occasional discharges of pus in the urine, and by the details of the physical characters of the swelling.

Prognosis.—The prognosis is always grave, and becomes increasingly so as the disease advances. The duration is commonly short, the case terminating in from a fortnight to a month; sometimes, however, a case lasts several months. A favourable prognosis may be given when perforation outwards has taken place; or when the abscess has burst internally, in such a direction that the pus escapes freely, and there is improvement in the general symptoms.

Treatment.—In the earlier stages counter-irritation by blistering may be useful. The internal use of iodide of potassium, and the external application of iodine, may prevent suppuration. Supporting diet should be given, but not stimulants unless essentially necessary.

When suppuration has taken place, the abscess must be discharged by the aspirator, or by free incision. The latter is preferable, because there are often sloughs or masses of tissue which cannot be got rid of by aspiration. When operation by incision is resolved upon, the incision should be made in the lumbar region through the skin and muscular

tissues; and the finger should be introduced into the abscess cavity, to tear down any adhesions which may exist. When the pus has been evacuated, a drainage-tube should be introduced, so as to keep the passage open, and give free egress to the pus. The best results are to be expected when free incision is adopted, and Lister's antiseptic method rigorously employed during the operation and afterwards. The patient's strength must be maintained by nutritious food, tonics, and stimulants when required.

T. Grainger Stewart.

PERINEURITIS (περί, around; and νεῦρον, a nerve).—Inflammation of the connective-tissue sheath of a nerve, usually more or less associated with neuritis. *See* Neuritis.

PERIOD OF INCUBATION.—The period that elapses between the entrance of an infective agent into the system and the first appearance of the symptoms of the disease which it produces. *See* Incubation.

PERIODICITY IN DISEASE.—In the older physic the periodical phenomena observed in many diseases exercised an important influence upon medical opinion and practice. In the physic of the present day these phenomena, although not disregarded by current pathology, have scarcely a place in therapeutical teachings. An increased precision of medical observation, while leading to the removal of many errors of the older writers on the subject, has begotten a general doubt as to its value in practical medicine, and has brought about a rejection of the earlier views respecting it perhaps too indiscriminate.

1. **Periods of Days and of Weeks. Critical Days.**—Two modern writers in this country, Dr. Thomas Laycock and Dr. Edward Smith, devoted attention to the phenomena of periodicity in disease. Laycock, from a general review of the periodical phenomena observed in menstruation, in utero-gestation, in the development of the ova of fishes, and in the metamorphoses of insects, came to the conclusion that physiological changes occur in animals every three and a half, seven, fourteen, twenty-one, or twenty-eight days, or at some definite number of weeks. In other words, he came to the conclusion that there are certain 'critical days' in health, days in which there are marked changes in the vital movements, whether that change be for the better or the worse; and that those days may be stated generally as the fourth, seventh, fourteenth, twentieth (or twenty-first), and the twenty-eighth. Further, from a review of the periodical phenomena observed in disease, particularly in the groups of eruptive, intermittent, and continued fevers, and in gout, he endeavoured to show that the changes observed in them followed a similar rule of periodicity to that manifested in health. He saw reason, moreover, having regard to the three-and-a-half day period noticed, or seven half-days, to revert to the ancient division of the whole day (νυχθήμερον) into two parts, here following Graves, who had said: 'We should not count three days and a half, but seven half-days; we should not say seven days, but fourteen half-days. If this method were adopted, many of the apparently critical terminations in continued fevers would, I have no doubt, be found strictly conformable to some regular law of periodicity.' Laycock also saw reason to revert to the ancient doctrine of *critical days in fever*, and he thus elucidates it: 'In the essay on the judicatory or critical days, found among the writings of Hippocrates, a critical day is shown to be that day on which certain symptoms will appear, enabling us to ascertain—first, the probable duration or termination of the disease, and, secondly, the symptoms likely to appear on certain future days. The acts of mind which deduced these inferences were termed judications (*judicationes*—κρίσεις); and the day on which those acts were to be made was termed judicatory (κρίσιμος). So a day might be judicatory—first, of the disease, its course and termination; secondly, of the symptoms to happen on another day. Thus jaundice and hiccup, appearing on the fifth day of fever, indicated a fatal disease; jaundice, on or after the seventh, indicated diaphoresis; on the seventh, ninth, eleventh, and fourteenth (if unaccompanied by hardness in the præcordia), a favourable termination. In pleurisy, if the fever abates on the seventh day, the patient will recover; if it do not, the disease will be prolonged to the fourteenth, on which day it is sometimes fatal. This is the first and plainest exposition of the doctrine of critical days, and, I believe, it is correct.' Laycock then proceeds to make a comparison of the critical days of febrile diseases, and the order of sequence observed by intermittents; and, further, to compare both these forms of fever with the periodicity observed in the exanthemata, and make the facts bearing upon that part of their pathology harmonise with each other. 'The critical days, according to Hippocrates [doubtless here writing, without knowing he did so, of what we now call continued fevers], are: 1, 4, 7, 9, 11, 14, 17, 20, or 21. The paroxysms of a tertian will take place on the $\frac{1}{1}$p. $\frac{3}{2}$p. $\frac{5}{3}$p. $\frac{7}{4}$p. $\frac{9}{5}$p. $\frac{11}{6}$p. $\frac{13}{7}$p. $\frac{15}{8}$p. $\frac{17}{9}$p. $\frac{19}{10}$p. $\frac{21}{11}$p. The paroxysms of a quartan will take place on the $\frac{1}{1}$p. $\frac{4}{2}$p. $\frac{7}{3}$p. $\frac{10}{4}$p. $\frac{13}{5}$p. $\frac{16}{6}$p. $\frac{19}{7}$p. And if a continued fever existed with tertian or quartan exacerbations, the more violent symptoms might be expected to appear on the days indicated. On comparing the order of days, discrepancies between the three are sufficiently obvious on a superficial consideration, but many of them disappear on

more particular inquiry. . . . With regard to the exanthematous fevers, it will be seen at once that the "critical days" they exhibit occur in quartan order. . . . Exanthematous typhus exhibits the tertian type, and, as might be inferred, the critical days in this fever are the fifth, seventh, ninth, eleventh, and twenty-first. Scarlatina is sometimes tertian, sometimes quartan.'

Since the discrimination of the several varieties of continued fevers, and after the date when Laycock wrote, medical observation has not tended generally to support the doctrine of critical days, as it relates to this group of febrile disorders, or to confirm the evidence upon which that doctrine appeared to be founded. Murchison's observations (*Treatise on the Continued Fevers of Great Britain*, 2nd ed., p. 187) did not support the applicability to *typhus*; but in this respect, as he notes, they were not in accord with the observations of Gairdner, Russell, and Traube of Berlin. The last-named, indeed, as also Wunderlich, revived the doctrine. *Relapsing fever* may, perhaps, be said to illustrate the doctrine, the paroxysm intermitting on the third, fifth, or seventh day. According to Murchison, the doctrine fails with respect to *enteric fever*, but he adds that he had 'often noticed' that the disease terminated about the 21st or 28th day. E. Seguin (*Medical Thermometry*, 1876) reproduces the views of Hippocrates on critical days, and Wunderlich's seeming confirmation of them derived from thermometry, himself accepting the 'similitude,' indeed the 'quasi-identity of the results' obtained, in this regard, by the father of Physic and the modern professor. According to Wunderlich's observations, the majority of cases of typhoid fever run a regular course, divided into periods corresponding in time with the division into weeks and half-weeks. The ordinary course is about twenty-one days, and Seguin describes an 'effervescence of seven days, a fastigium of seven days, and a defervescence of seven days;' but he adds, with reference to the irregularities which so often mark the disease, 'simple as it looks, how difficult it is to make it out.' In typhus—simple uncomplicated cases—the thermometer marks the fourth day as the height, the sixth to the seventh as the turning point, and a *perturbatio critica* at the end of the second week. 'The doctrine of crises,' says Wunderlich, 'was for the ancients a dogma . . . for us it must become a law.' Robert Lyons remarks (*Treatise on Fever*, p. 74, 1861): 'We are far from denying that at certain periods febrile disease presents an unmistakable tendency to terminate on critical days; but we think that it is consistent with observation to state that a critical issue of fever . . . is far less common in our day than it once was.' And this, indeed, would appear to be a legitimate conclusion from the observations made in this country bearing on the subject. It would almost seem, in fact, on comparing the critical days set forth by the older writers with the order of sequence followed by the paroxysms of intermittent fever, as if the indications of the former, in the progress of the continued fevers of Great Britain at least, had declined with the diminution of sources of paludal malaria.

Laycock, as the general result of his investigation of the *minor* periods—that is, the daily, weekly, monthly, and seasonal recurrences of vital movements—as contra-distinguished from the *major* periods, that is, periods measured by a year, or by a series of years (which he also discussed, but which will be referred to in this article in another connexion), laid down the following propositions: (1) There is a general law of periodicity which regulates *all* the vital movements of *all* animals. (2) The periods within which these movements take place admit of calculations approximatively exact. (3) The fundamental unit—the unit upon which these calculations should be based—must for the present be considered as one day of twelve hours. (4) The lesser periods are simple and compound multiples of this unit, in a numerical ratio analogous to that observed in chemical compounds. (5) The fundamental unit of the greater periods is one week of seven days, each day being twelve hours; and simple and compound multiples of this unit determine the length of these periods by the same ratio as multiples of the unit of twelve hours determine the lesser periods.

Inquiring into the causes of the periodical changes in the vital movements of animals, Laycock saw reason to believe that they were in part dependent upon cyclical processes inherent in the system (*esoteric*), partly upon periodic agencies acting from without (*exoteric*), or that they resulted from a combination of the two (*endexoteric*). Prosecuting the inquiry further with special reference to the exoteric agencies, Laycock showed how closely the periodical changes observed in vital movements were linked to the periodical phenomena observed in nature at large, and this not merely with reference to such obvious phenomena as the alternation of sleeping and waking, in connexion with the diurnal rotation of the earth, and the succession of day and night, but also in respect to the more recondite periodical changes in the vital processes. He set forth data which suggested that those changes, as well as the periodical changes observed in disease, had definite relations to the position of the earth with reference to the sun, and to the position of the sun among the spheres: also to the periodical fluctuations occurring in atmospherical temperature, pressure, and magnetism; and in the magnetism of the earth, whether diurnal, seasonal, or secular. And of the periodicity observed in pathological

processes, he endeavoured to show that (whatever the intimate nature of the pathological process might be) neither the beginning, the continuance, the fluctuations, the ending, nor tho recurrence could be rightly understood apart from its relations to the phenomena of physiological periodicity on the one hand, and the periodicity of physical phenomena on the other hand. He held that there were not wanting indications in pathological phenomena of a lunar period, and particularly of a lunar cycle (eighteen years, Howard's seasonal cycle); the indications of solar periods were more obvious; and it was to be inferred that in time we should have evidence of greater pathological cycles corresponding with the greater astronomical cycles. Laycock, indeed, saw clearly that, so far as exoteric agencies were active in bringing about the periodical phenomena observed in physiological and pathological processes in man, the changes of least period were linked inextricably to the changes of greatest period, and that the study of the greater periods must be approached, if success were to be hoped for, through the study of the lesser.

Laycock was of opinion that as our knowledge of the periodical phenomena observed in vital changes becomes more exact and extensive, it will be possible to establish a science of *vital proleptics*, having for its object 'to foretell social and individual suffering'—in other words, a science of *pathological forecasting*.

Edward Smith examined the question of periodical changes in living beings, in health and disease, from a standpoint different from that taken by Laycock. He limited his observations to the human system, and prosecuted a series of researches on the daily, weekly, and seasonal changes it underwent, probably unique in their duration and extent. He adopted as criteria of these changes the rates of pulsation and inspiration, the quantities of carbonic acid expired, of air inspired, and of urea and urinary water evolved. The data as to these several changes were determined by a series of observations made upon himself and others, some phthisical, at hourly intervals, without intermission, throughout the twenty-four hours, during several days in succession, for the daily poriod, and at daily intervals for the longer periods of time. The fluctuations observed in the different phenomena of health being taken as indications of changes in tho activity of tho vital processes, it became possible to determine the progression and retrogression of that activity within the several periods to which the inquiry was directed. Theso may be briefly stated as follows:—

Daily period (*cycle*).—Vital activity is at the lowest between the hours of 1 and 3 o'clock A.M. After 3 o'clock A.M. the activity increases, at first slowly, then more quickly, until a maximum is reached between the hours of noon and 2 P.M. A progressive decline follows, rapid at first, slower as the evening draws on and falls into night, until the minimum is reached between 1 and 3 A.M. The day, in fact, as concerns the changes undergone in the human system may be divided into two periods, one of minimum change (approximately from 8 P.M. to 8 A.M.); and one of maximum change (approximately from 8 A.M. to 8 P.M.) Within this daily cycle, smaller cycles are observable, according to the time and quality of the meals.

Weekly period (*cycle*).—A weekly period is not shown by a clear line of progression of vital change throughout the week, but by the indications of a higher degree of change which follow upon the first-day rest than are manifested at the close of the sixth day of labour. The evidence of a seven-days period of change in the healthy system, on the line of investigation pursued by Smith, and apart from the social habit of periodical rest, is obscure; but the social habit is probably the expression of a physiological want of the system.

Seasonal (*annual*) *period* (*cycle*). —A seasonal cycle is very definitely marked by the intimate vital changes observed in the human system. Towards the close of summer vital change has reached its lowest point. With the commencement of autumn a progressive increase commences, which continues through the autumn and the winter, and reaches its highest degree in spring. Towards the close of spring vital change begins to decline progressively. This decline proceeds throughout June and July, at an increasing rate in the latter month, and attains its lowest degree early in September. The *summer* changes in the system exhibit the following minimum and maximum conditions: a *minimum* of carbonic acid and vapour exhaled, of air inspired, of the rate and force of inspiration, of alimentation and assimilation, of animal heat generated, of muscular tone and endurance of fatigue, and, in general, of resistance to adverse influence. A *maximum* of the rate of pulsation, of the action of the skin and the elimination of vapour, of the dispersion of heat, of the supply of heat from without, and of excess of heat, of the elimination of urea and urinary water, of the distribution of blood to the surface, of the imbibition of fluids, of relaxation of the tissues, and of poverty and carbonisation of blood. In the *winter season* tho above conditions are, for the most part, reversed. Tho *autumn season* is marked by tho conditions peculiar to the summer or the winter, as the character of the soason resembles the ono or tho other; it is essentially a period of change from tho minimum to the maximum. Tho *spring season* is characterised in its early and

middle parts by the highest degree of efficiency of every function of the human system, but as the season advances to the close, these conditions merge into those peculiar to summer.

The effect of season, Edward Smith observes, is more than the physical phenomena of temperature and atmospheric pressure explain, and is so universal that even the same amount of exertion, made at two different seasons, produced different degrees of effect upon the vital changes—less carbonic acid being evolved from it in summer than in winter, in proportion to the relative amounts when at rest at these two periods.

The periodical changes here set forth have important bearings both upon the liability to, and the treatment of disease. Smith endeavoured to formulate these bearings, and thus to furnish a rational statement of many facts which the experienced practitioner learns at the bedside, and which he applies empirically.

But the interest of the seasonal period is more conspicuously marked as it influences the liability to and recurrence of disease and particular kinds of disease. And here it should be noted that Edward Smith discusses a question which, perhaps, has been too little considered, namely, the viability of children born in the different seasons of the year. This question he believed to have an important bearing upon the great loss of infant life which occurs in the summer season. Smith concludes that the viability of those children is greatest who are born in the winter and spring months.

Later and more reliable observations show that the periodical fluctuations observed in the progress of certain current diseases in the course of the year, appear to be largely determined by the influence of seasonal changes on the individual. This subject has been examined by Dr. Alexander Buchan and Sir Arthur Mitchell (*Journal of the Scottish Meteorological Society*, Nos. xliii.-xlvi.), with reference to the variations of mortality in relation to the weather for different diseases, at different ages, in London, for a period of thirty years. The results obtained by these authorities are of exceptional value, from the length of period over which it has been practicable to extend their examination. More recently Longstaff has added considerably to our knowledge of this subject. A series of researches made by Dr. Edward Ballard, on the prevalence of certain sorts of sickness, in a particular district of London, with reference to meteorological conditions, corresponds closely with the results shown for the mortality in similar kinds of sickness by Buchan and Mitchell, the minima and maxima of the sicknesses necessarily preceding by a longer or shorter period the minima and maxima of the mortality arising from them. The general results obtained from the London mortality may be taken as representing the influence of seasonal changes on disease; but the Registrar-General has shown that in measles, to take one instance only, a second and greater maximum which is so conspicuous in the London curve assumes only small dimensions in several English towns, the spring maximum being the more constant. In New York the scarlet-fever curve is practically reversed, the maximum being in spring and the minimum in autumn. The accompanying diagrams (figs. 111–116), published by the Registrar-General in the Annual Summary for 1890, show the seasonal mortality of some of the more important diseases current in London.

2. Periods of Seasons or of Years.—Epidemics.—A series of periodical phenomena have now to be considered which have been a source of the most eager speculation from the earliest times of medicine to the present day. So far as medicine is concerned, these periods have been marked by epidemic morbid phenomena—epidemics in man, epizootics in animals, epiphytics in plants. The recurrence of these phenomena at intervals shows that over and above the periodical morbid changes which have hitherto been noted, and which are completed within the day, the week, or a series of weeks, and the seasons within a year, there are periods of change which require for their completion a series of years of longer or shorter duration, and which for their elucidation (as Laycock showed) require to be considered in connexion with the previously mentioned periods. These periodical morbid phenomena are of two sorts, the one relating to particular localities, districts, or countries (*epidemics*); the other to groups of several countries or to the world generally (*pandemics*). There are, in fact, circumscribed (local) and general epidemics, the small and the great epidemics of some writers; the former, local evolutions of disease having relation chiefly to the physical and moral states of communities; the latter, secular evolutions (to use Charles Anglada's phrase: *Maladies Éteintes et les Maladies Nouvelles*, 1869), which appear to be governed by as yet undetermined laws. To these secular evolutions of disease some epidemiologists would restrict the term 'epidemic.' *See* EPIDEMIC.

The law of periodicity of the several diseases current in a country, and which are apt to become epidemic, being as yet undetermined, each disease has to be considered apart; and in those which are communicable from the sick to the healthy, the influence of an accumulation of susceptible persons in the intervals between epidemic prevalence, which formerly was considered an important factor in epidemicity of one and another disease, is coming to be regarded as subordinate to conditions appertaining intrinsically to this and the other virus.

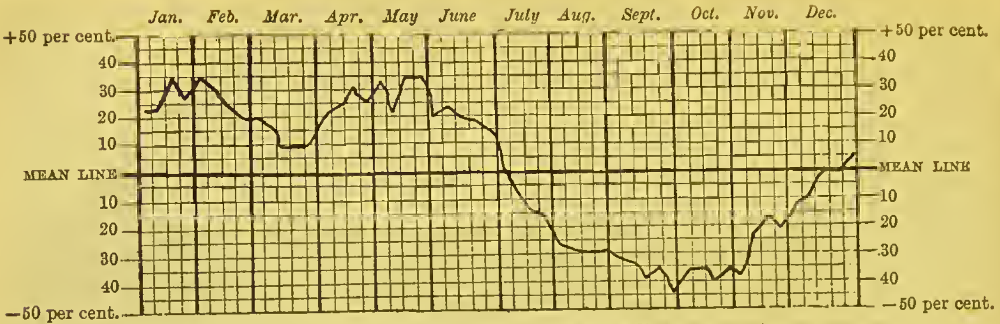

FIG. 111.—Small-pox (50 years, 1841–90). The mean line represents an average weekly number of 17 deaths.

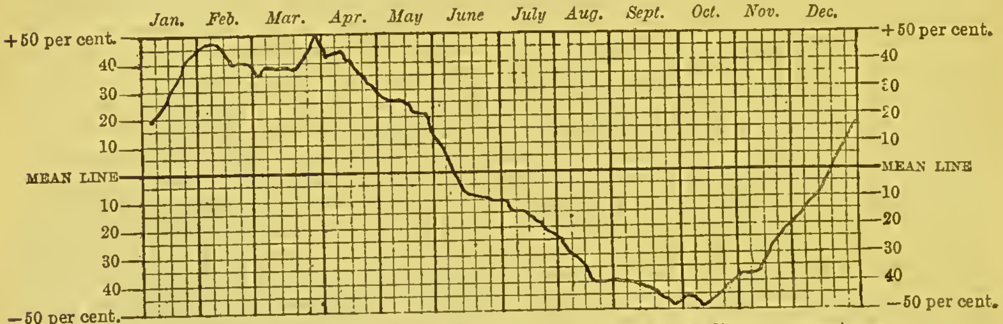

FIG. 112.—Whooping-Cough (50 years, 1841–90). The mean line represents an average weekly number of 47 deaths.

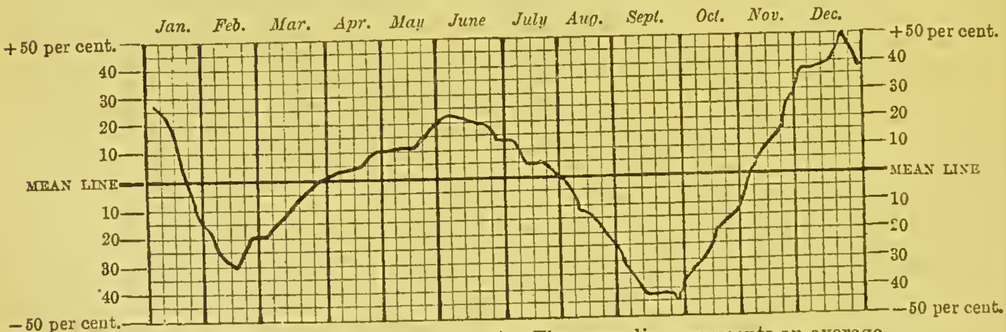

FIG. 113.—Measles (50 years, 1841–90). The mean line represents an average weekly number of 34 deaths.

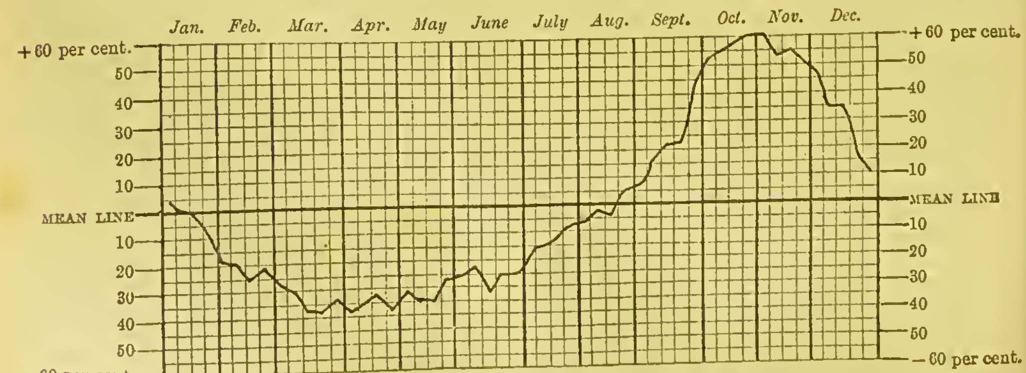

FIG. 114.—Scarlet Fever (30 years, 1861–90). The mean line represents an average weekly number of 44 deaths.

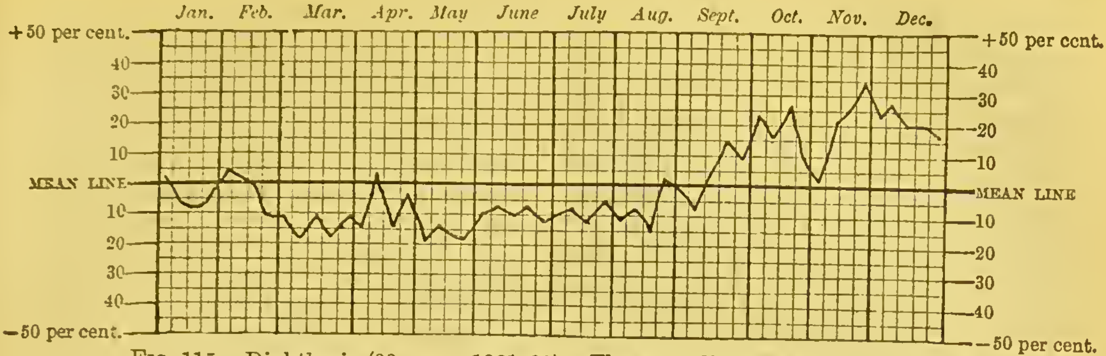

FIG. 115.—Diphtheria (30 years, 1861–90). The mean line represents an average weekly number of 13 deaths.

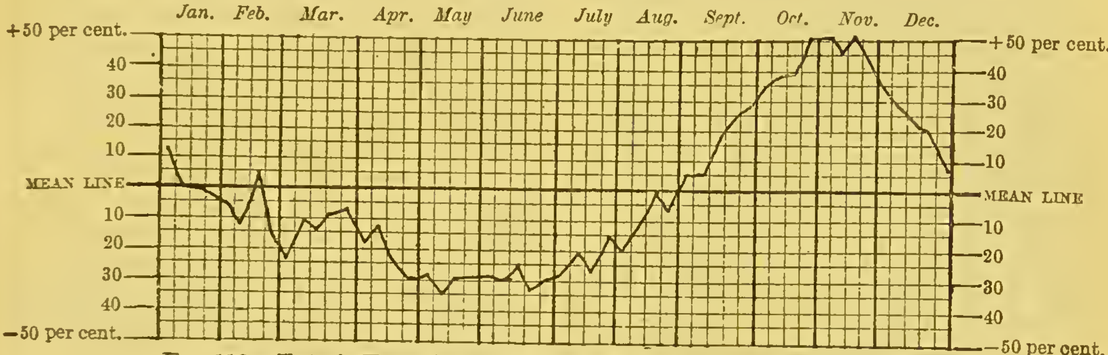

FIG. 116.—Enteric Fever (22 years, 1869–90). The mean line represents an average weekly number of 16 deaths.

Dr. Longstaff (*Studies in Statistics*) has brought out some new and important points in regard to the broader cycles which extend over periods of years. He found that from 1855 to 1880, not only in London, but also in England generally, scarlet-fever mortality rose and fell with considerable regularity at intervals of five or six years, the actual maxima having occurred in 1858, 1863–64, 1869–70, and 1874. This curve was also followed (more or less closely) by a group of diseases which in their seasonal distribution are most like scarlet fever. As regards erysipelas, puerperal fever, and rheumatism of the heart, the parallelism is almost complete, and there are plain indications of affinity in those of laryngitis, diphtheria, croup, and quinsy. During the last decade, however, with declining mortality the rhythmic recurrence of scarlet fever has ceased to be perceptible in mortality returns. Meanwhile small-pox has become epidemic about every four or five years, in London at all events; measles at intervals, which as Munro (*Trans. Epidem. Soc.*, vol. x. p. 104) and others have shown, average about two years in most towns, but may be longer or shorter; and whooping-cough at still less regular intervals of two or three years. These three diseases, as already stated, have no similarity to the scarlet-fever group in their seasonal curve. Another group, of which diarrhœa is the most prominent representative in this country, reach their annual maximum shortly after the highest temperature of the year is attained; their true relation, according to recent observations, being with the temperature of the soil at a greater or less depth from the surface. Diarrhœa often shows a curious tendency to biennial sequence of alternately high and low mortality; but on investigation, this, when it occurs, is usually sufficiently explained by alternation of hot and cold summers. Dr. B. A. Whitelegge has shown that, whatever their causes may prove to be, these cycles, like the seasonal changes characteristic of each disease, are too definite to be regarded as due to accident. Nor are they likely to be purely mechanical in origin, for they vary not only with each disease, and to some extent with locality, but also from decade to decade. There is reason to believe that they are connected primarily with variations in the quality of the contagium itself. As a general proposition, it may be stated that the years of greatest mortality are those in which both the prevalence and virulence are greatest. As regards scarlet fever, the case-mortality (that is, the percentage of fatal cases), if traced year after year, seems to yield a curve which is almost parallel with that of the scarlet-fever death rate. Statistics are wanting in respect of the case-mortality in measles, but occasionally, as at Sunderland in 1885 and Hanley in 1889, an exceptional virulence and severity of type are observed; and in these and other

instances it has been found that for some ten years previously the usual biennial waves have gradually increased in destructiveness, as shown by the records of mortality. Upon similar evidence it may be suspected that small-pox declined in average virulence, as it certainly did in average mortality, from about 1838 to about 1855, increasing again to a maximum in 1871, and thenceforward declining again until 1888 or 1889. Here, however, the question is further complicated by the dominant influence of vaccination, in addition to the social and climatic conditions which are obviously concerned in promoting or retarding epidemic extension.

Again, with regard to cholera and 'fevers,' it must here be noted that Dr. Robert Lawson holds, from a widely extended range of observation, that a series of fluctuations may be distinguished in the prevalence of cholera and 'fevers' following in regular sequence at intervals of two years. These fluctuations are common to both hemispheres; and as they appear to move from east to west, he has designated them '*pandemic waves.*' These waves have a definite relation, he believes, to the magnetic isoclinal lines, and he has laid down rules for determining their position at any time (*Trans. Epidem. Soc. of Lond.* vol. iii. p. 216).

The facts relating to the secular evolutions of diseases are amongst the most interesting, if the most lugubrious, in the history of the human race. Although their too frequent obscurity and their extreme complexity have hitherto interposed an insuperable barrier to the construction of a general doctrine regarding their occurrence, it is not the less necessary that they should receive attention. Here it is possible only to note some of the more salient indications of secular periods of morbid evolution. The following illustrations (chiefly according to Anglada) may be mentioned:—

(*a*) The great *pestilence* of the fifth century before Christ, of which the so-called 'plague of Athens,' as described by Thucydides, was an incident.

(*b*) The pestilences of the second and third centuries of the Christian era, which are believed to have been of the same nature as the pestilence of the fifth century B.C. After the third century this form of pestilence disappeared from history.

(*c*) The explosion of *bubonic* (*inguinal*) *plague* in the sixth century after Christ, when, for the first time in history, this formidable disease assumed the epidemic character which it maintained to the early part of the present century. Breaking out in the reign of Justinian (A.D. 542), the disease quickly occupied the whole of the then known earth, and began a tragic course which has continued even to our own time. For twelve hundred years it had held a pre-eminence among pestilential maladies, sometimes more, sometimes less prevalent, but at all times deadly. In the sixteenth century, when quarantine was established (*see* QUARANTINE), 69 outbreaks of the disease were recorded in Europe, of which five happened in England; in the seventeenth century, 56, six in England; in the eighteenth century 28, none in England; and in the first half of the nineteenth century, 15. In the seventeenth century, the area of prevalence of the disease began to decrease. This decrease went on progressively throughout the eighteenth and the commencement of the nineteenth centuries, the latest outbreaks of the malady, however, being not less fatal than the earliest; and in 1844 it apparently became extinct. But about ten years afterwards the disease again showed itself in the Levant, and from that time to the present scattered circumscribed outbreaks have occurred in Western Arabia (1853, 1874, and 1879), North Africa (1855–59 and 1874), Mesopotamia (1867 and 1873–77), Persia (1863, 1870–71, and 1876–77), and, after an absence of thirty-six years from Europe, in the province of Astrakhan, Russia (1878–79).

The sixth century most probably also gave birth to or determined a new phase of activity in small-pox, measles, and even scarlatina, as great epidemics.

(*d*) The *gangrenous pestilence* of the middle ages (tenth, eleventh and twelfth centuries), a disease long extinct.

(*e*) The *black death* of the fourteenth century, a disease held by the most competent writers to differ essentially in nature from bubonic plague, and long extinct—unless, indeed, according to some writers, the Pali plague of India is to be regarded as the dregs of the *black death* of the fourteenth century. *See* PLAGUE.

(*f*) The *sweating sickness* of the fifteenth and sixteenth centuries, which, born towards the close of the former century, after five visitations (1485–86, 1507, 1518, 1529, and 1551) disappeared, about the middle of the latter century.

Also, the great epidemic of *syphilis* of the fifteenth century.

(*g*) The *choleraic pestilence* of the present (nineteenth) century.

(*h*) The exceptional development of fatal *diarrhœa*, especially of *infantile diarrhœa*, in this century.

(*i*) The occasional extension of the *yellow fever* of the tropics into Europe, notably at the beginning of the present century.

(*j*) The great development of *diphtheria*, a disease that had been well-nigh forgotten, within the past thirty years.

(*k*) The appearance within recent years of *cerebro-spinal fever*.

In these phenomena we have evidence of secular pathological changes, to which a clue has been sought in studying their relation with secular meteorological and telluric

changes. In the epidemics of short recurring periods—the lesser epidemics, so to speak—it is possible to construct a theory of recurrence, founded on the relationship of man to his physical and social surroundings, and the periodical changes which he and they undergo, in common with and in subordination to the periodical changes observed in Nature at large. In the epidemics of long recurring periods—the greater epidemics—the same conditions obtain; but it would appear as if there were in addition some slowly developed cumulative influences at work, which manifest themselves only after long intervals of time. So far as these influences may be linked with meteorological changes we look principally to India, where these changes are more uniform in their occurrence, for the earliest clear light on the subject. There, for example, cholera is constantly present—now as a disease endemic to a particular region, now as a widespread epidemic within the limits of the peninsula, but ever and anon breaking its bounds and spreading pandemically throughout the world. Dr. James L. Bryden has shown that the different developments of cholera within the boundaries of India have definite relations to particular meteorological phenomena; and it seems not unreasonable to suppose that, following the line of research inaugurated by him, in progress of time it will become possible to discriminate between the meteorological changes which influence or concur with epidemic prevalence of the disease within India, and those which influence or concur with wider extensions of the malady—such as affected Europe in 1829-37, 1847-50, 1852-56, 1865-67, and 1869-73. Blandford's meteorological researches may be thought of as promising help in this direction, inasmuch as they are tending to show a relation between the greater cycles of meteorological change in India and cycles of meteorological change in the sun's atmosphere, particularly as observed in the sun-spot period.

It might here be added that the well-known observations on the appearance and disappearance of the spirillum in relapsing fever, seem to suggest a direct connexion between the periodical character of this disease and the life-cycle of the organism.

J. Netten Radcliffe. Shirley Murphy.

PERIOSTEUM, Diseases of.—*See* Bone, Diseases of.

PERIPHERAL (περί, around; and φέρω, I carry).—Of or belonging to the periphery or circumference, as opposed to the centre. The term is now applied chiefly to morbid conditions connected with nerves or their terminations, as distinguished from those situated in the nerve-centres, for example, *peripheral paralysis*, *peripheral pains*. Peripheral may also be associated with the vessels, as distinguished from the heart, for example, *peripheral resistance*; and with the outer zone of the lobules of glandular organs, as, for instance, of the liver.

PERIPHERAL NEURITIS.—*See* Neuritis, Multiple.

PERIPNEUMONIA NOTHA (περί, around; πνεύμων, the lungs; and νόθος, false). An obsolete term, which was formerly vaguely applied to a variety of forms of acute inflammation of the bronchi and lungs.

PERIPROCTITIS (περί, around; and πρωκτός, the anus).—Definition.—Inflammation of the tissues surrounding the rectum.

The lumen of the rectum is normally, except in the act of defæcation, obliterated by the mucous membrane being thrown into folds from contraction of the muscular coat of the bowel; so that a transverse section of it in this state would present the appearance of a solid oval, with the long diameter transverse. During defæcation the bowel is distended by the passage of fæces, and in persons subject to constipation or flatulence this distension is often found considerably increased by accumulations of fæces or of flatus. The rectum is, in order to admit of this mobility, surrounded by a considerable quantity of loose cellular tissue, which below passes by direct continuity into the masses of adipose tissue which fill the ischio-rectal spaces.

In consequence of the dependent position, the comparatively great exposure to injury, the vascularity and the liability to congestion from the junction of the portal and systemic venous systems, this cellular tissue is very liable to inflammation, which usually goes on to suppuration.

Periproctitis may be either *acute* or *chronic*.

Ætiology.—*Acute* inflammation around the rectum may be of traumatic origin. Unskilful catheterisation in the male subject, by which the point of the catheter is forced through the urethra into the space between the bladder and rectum; penetrating wounds of the bowel, caused by instruments, such as injection-tubes, stricture-dilators, &c., or by foreign bodies introduced by patients themselves, or by sharp substances, such as fish-bones, which have been accidentally swallowed; gunshot wounds of the part; penetrating wounds, caused by falls on sharp substances; or even contusions, the result of falls or kicks, may set up such inflammation. Or it may be the result of extension of inflammation from surrounding parts. Thus prostatitis, cystitis, pericystitis, ulceration in the membranous portion of the urethra, sloughing ulceration of the vagina, and the various kinds of ulcers in the rectum, may be the exciting cause. If perforating ulcers be the cause, so as to lead to extravasation

of urine or fæces, the inflammatory process is very severe. In some rare cases no exciting cause can be traced, and such cases are known by the misleading name of 'spontaneous periproctitis.'

Chronic periproctitis always results from the extension of inflammatory processes from neighbouring parts. Disease of the sacrum, coccyx, or lower lumbar vertebræ, or chronic disease of the pelvic viscera, often leads to it. It is characterised by considerable infiltration and thickening of the cellular tissue, as well as by suppuration. Pyæmia resulting from ligature of hæmorrhoids may be attended by abscesses in this tissue; which also, though very rarely, have been found in pyæmia from other causes.

Symptoms.—In acute cases the patient complains of a feeling of weight in the part, and of pain, which is much greater during defæcation. As the thickness of the integument in this region, and the fasciæ of the part, retard the pointing towards the surface, extensive mischief may exist with little external sign. Hence the importance in all suspected cases of careful digital exploration of the rectum, by which local tenderness, increased temperature, and either hardness or fluctuation, according to the stage of inflammation, may be detected. In chronic cases the symptoms are usually masked by those of the exciting cause.

Treatment.—In all such cases accumulation of fæces in the rectum must be prevented by the use of simple enemata; whilst in acute cases early surgical interference is imperatively required. In other cases, the exciting cause must be discovered and treated according to circumstances.

Jeremiah McCarthy.

PERITONEUM, Diseases of.—The peritoneum is by far the most extensive serous membrane in the body, while it has numerous folds and attachments, and is in relation with several organs and other structures, so that the consideration of its diseases, though similar in their nature, is a much less simple matter than in the case of the other membranes of this class. It must also be remembered that in the female the peritoneal cavity is in direct communication with the uterus, through the Fallopian tubes. The morbid conditions of the peritoneum may be discussed according to the following arrangement:—

(1) Peritoneum, Acute Inflammation of; (2) Peritoneum, Chronic Inflammation of; (3) Peritoneum, Gas in; (4) Peritoneum, Dropsy of; (5) Peritoneum, Hæmorrhage into; (6) Peritoneum, Injuries to; (7) Peritoneum, Morbid Formations and New-Growths in; (8) Peritoneum, Malformations of.

1. Peritoneum, Acute Inflammation of.—Synon.: Acute Peritonitis; Fr. *Péritonite Aiguë*; Gr. *Acute Bauchfellentzündung*.

Ætiology and Pathology.—Acute peritonitis may arise under several conditions, which can be conveniently included under certain heads.

(*a*) *Traumatic.*—It was formerly believed that any kind of injury to the peritoneum was highly dangerous, and would lead almost inevitably to inflammation. Not only, however, may it be punctured with an aspirator or trocar without any harm resulting, but it may even be freely opened and manipulated, under proper aseptic or antiseptic conditions, without any injurious effects, as is constantly exemplified in various operative procedures at the present day. At the same time, a very slight operation affecting the peritoneum may lead to serious or even fatal peritonitis, if septic matters are introduced into its cavity. Penetrating wounds of the abdomen are very likely to be followed by peritonitis, but not necessarily. The rupture by violence of an abdominal organ, should the patient survive long enough, will also lead to this result, from the escape either of blood or of the contents of a hollow viscus. Peritonitis has been attributed to a mere contusion over the abdomen. When it arises from a wound, it is not the simple injury to the peritoneum that causes the lesion, but its exposure to impure air, the direct introduction of septic matters, or hæmorrhage into the peritoneal sac.

(*b*) *Perforations and Ruptures.*—In addition to lesions due to injury, there are several other kinds of perforation and rupture which are liable to give rise to peritonitis. These have been discussed at length in a special article (*see* Perforations and Ruptures), and it will suffice to mention here, that acute peritonitis may follow either of the following forms of perforation or rupture: (i.) of hollow viscera, with escape of their contents, especially the stomach, intestines, appendix vermiformis, gall-bladder, or urinary bladder; (ii.) of solid organs which have become so softened as to give way; (iii.) of cystic or other localised accumulations of serous or other fluids; (iv.) of collections of pus in connexion with any structure within the abdomen, even with the peritoneum itself, or in the abdominal wall; (v.) of an aneurysm; (vi.) of a dilated receptaculum chyli; (vii.) of fluid accumulations within the chest, which have opened through the diaphragm into the abdomen, such as empyema, pulmonary abscess, or a hydatid cyst. The degree and characters of the peritonitis depend mainly on the materials which thus gain access into the peritoneal sac, whether gaseous, liquid, or solid, and which irritate it more or less according to their nature. Urine is one of the most virulent of such materials; and unhealthy pus or gangrenous fragments are also highly injurious.

(c) *Direct irritation of the peritoneum.*—This is a common source of peritonitis, and the irritation may be *general*, affecting more or less the whole peritoneum; or *local*. Thus it is probable that *general* irritation may result from distension of the peritoneal sac in extreme cases of ascites; and certainly from extensive morbid deposits, such as cancer or tubercle. *Local* irritation may be excited by many different conditions, including mere mechanical pressure or friction, as from a malignant or other tumour, an enlarged cancerous organ, or an accumulation in the bowels; as well as localised inflammation, suppuration, ulceration, or gangrene. A very severe form of peritonitis is liable to be set up by a strangulated hernia or certain forms of acute intestinal obstruction. Even chronic obstruction, or impaction of fæces, may cause peritonitis, but then this is preceded by ulceration and perforation of the bowel above the difficulty. This complication may also result from the spreading of putrid inflammation in typhoid fever, without any perforation; and it has occurred in this disease in connexion with an ulcerated gall-bladder, or a suppurating embolus in the spleen. It is occasionally associated with dysentery. Other causes to be mentioned in this connexion are a sloughing embolus in the spleen, due to ulcerative endocarditis, suppurative inflammation of the kidney, tubercular glands, typhlitis and perityphlitis, associated with lesions of the appendix vermiformis. In some instances a minute and careful search has to be made for the source of irritation before it can be discovered; for instance, it may be merely a suppurating absorbent gland, deeply situated. Peritonitis thus originating may be limited, or may spread universally, this depending very much on the nature of the irritant.

(d) *Extension.*—Besides the extension of peritoneal inflammation from a local irritation, it now and then happens that pleurisy or pericarditis, especially if of a septic nature, spreads through the diaphragm to the peritoneum, probably by means of the system of lymph-canals existing between the serous membranes and the diaphragm. Inflammation may also pass along the Fallopian tubes directly from the uterus to the peritoneum. In this connexion it may further be mentioned that infectious emboli in branches of the abdominal aorta have given rise to peritonitis; and this disease has also been attributed to phlebitis and periphlebitis, extending from the umbilical and spermatic veins.

(e) *Secondary.*—This term refers to cases of peritonitis originating as a complication or local manifestation of some general condition. Under such circumstances the disease usually results from a morbid state of the blood—especially when it contains products of excessive or abnormal tissue-change—as in low fevers, certain irritants, or infective agents. Other causes may, however, assist in its development. The most important diseases in which secondary peritonitis occurs are Bright's disease, usually tubal nephritis, occasionally the granular kidney; septicæmia and pyæmia, though here there is generally some local cause to account for it; erysipelas, small-pox, glanders, anthrax, and other diseases of this class; and possibly acute rheumatism and gout. Erysipelas has caused peritonitis by extending through the abdominal wall. It has also been said to follow scurvy; but in a large number of cases of scurvy which came under the observation of the writer peritonitis never occurred. Under this head may be mentioned cases of peritonitis due to the effects of sewer-gas, of which there are some well-authenticated cases.

(f) *Idiopathic.*—Occasionally cases of peritonitis occur which cannot be referred to any of the recognised causes. These have been called *idiopathic*, and have been attributed to exposure to cold, excessive eating or drinking, and various other causes in individual instances. Their reality, however, is exceedingly doubtful.

(g) *Contagion.*—Peritonitis may be originated by contagion, especially when of the puerperal variety, and it may thus become epidemic.

It may be noted here that different micro-organisms have been found in the morbid products of peritonitis; and some believe that there are essential differences between the various forms of this disease. The chief organisms which have been met with are streptococcus pyogenes, staphylococcus pyogenes aureus or albus, bacterium coli commune, diplococcus pneumoniæ, and the amœba coli associated with dysentery.

Peritonitis in Females.—A few special remarks are called for on this point. Peritonitis is much more common in females than males, on account of the relation of the peritoneum to the uterus, and the various conditions connected with the genital organs and functions which are liable to affect this structure. The following are the principal causes coming under this head to which peritonitis has been referred: (1) the uterine congestion attending menstruation, aided by the effects of cold, especially if this should give rise to inflammation of the womb; (2) the puerperal state and its accidents, puerperal peritonitis being a most important form of the disease, which is discussed separately; (3) premature delivery, and especially the use of instruments in procuring abortion; (4) extra-uterine fœtation; (5) local diseases, such as inflammation of the womb or its lining membrane, or in the vicinity of the organ; ovaritis or sloughing of an ovary; uterine or ovarian tumours; peri-uterine hæmatocele; and inflammation, suppuration, or ulceration of the Fallopian tubes;

(6) gonorrhœal inflammation spreading upwards; and (7) injections into the cavity of the uterus. *See* Pelvic Peritonitis; and Puerperal Diseases.

Predisposing Causes.—In addition to sex, age has to be regarded as a predisposing cause of peritonitis. It is very rare in children, except in new-born infants, in whom it occurs comparatively frequently, either from inflammation or gangrene of the umbilicus, or from umbilical hernia; or as the result of infection from the mother. The affection is said to be not uncommon in the fœtus, causing its death. In children peritonitis is usually associated with the acute exanthemata or with pyæmia, even sometimes following vaccination; but it may also be due to tubercular disease or to intussusception, and in very rare instances has been traced to an undescended testis, or to injury in administering an enema. Peritonitis is predisposed to by previous attacks; and, it is said, by accumulation of fæces, and habitual excessive use of strong purgatives. Chronic Bright's disease may be regarded as a powerful predisposing as well as an exciting cause of the complaint, a very slight irritation readily setting it up when this affection is present.

Anatomical Characters. — The pathological changes in peritonitis present much variety under different circumstances, as regards their nature, progress, and extent; and although they resemble in a general way those observed in other serous inflammations, they exhibit in most cases distinguishing peculiarities of a striking kind.

In the early stage increased vascularisation is always noticed, but this may subside at a later period, or be obscured by the inflammatory products. There is capillary injection more or less diffused, the vessels being enlarged and elongated. This is often very marked, giving rise to intense redness, frequently not uniformly distributed, but being especially observed where coils of intestine touch each other, and at the starting-point of the inflammation in certain cases. The injection is also said to be in many cases especially marked along two longitudinal lines, which run over the bowel, at a little distance from one another, parallel with the attachment of the mesentery. Small extravasations of blood are not uncommon, and they may be numerous.

The products of the inflammatory process are very variable, as regards both their nature and amount. In certain cases they consist almost entirely of a fibrinous exudation or of organisable lymph, with a very little serum, often more or less tinged with the colouring matter of the blood, and containing flakes of lymph—*adhesive peritonitis*. The lymph is of a yellowish-grey colour, and at first very soft and easily separable, but afterwards it tends to become firmer and more adherent. It is deposited as a film, which is added to until by degrees it may attain considerable thickness. Usually the exudation forms a continuous layer, though of unequal thickness, but occasionally it occurs in separate patches. It mats together loosely, or more or less firmly, the coils of intestines; and covers the solid viscera, where it tends to attain a greater thickness. The subsequent progress of this form of peritonitis in cases of recovery is towards organisation of the lymph, and the formation of thickenings, bands of adhesion, and agglutinations, which may lead to grave consequences.

In a small proportion of cases of acute peritonitis a fluid effusion constitutes the principal morbid product, varying in quantity, and it may become so abundant as to distend the peritoneum to an extreme degree. There is a slight deposit of fibrinous exudation. The effusion may be mere serum, difficult to distinguish from ascites; while ascites may excite peritonitis, and thus lead to an admixture of inflammatory effusion. In other cases the fluid is sero-fibrinous, being spontaneously coagulable, and greenish-yellow, or turbid or milky; while flakes or larger fragments of lymph float in it. In this condition there is often much fibrinous deposit. If the fluid is absorbed, adhesions will subsequently form.

In the majority of cases of acute peritonitis the products tend to be of a lower type than those thus far described. The exudation is frequently soft and non-organisable, or sometimes greasy in appearance and to the touch; not uncommonly it is greenish-yellow, and infiltrated with pus-cells. The fluid is also more or less sero-purulent or actually purulent. It may be thick, laudable pus; or more liquid and unhealthy-looking; or discoloured, and more or less offensive and foul-smelling; or mixed with blood in various proportions, especially in scurvy and low fevers. Peritonitis associated with Bright's disease is generally suppurative. The pus accumulates mainly in the pelvis as a rule; but collections of it are also found between the coils of intestine, and in other parts, pent up by lymph or adhesions, which look like abscesses, and may be of some size. These collections sometimes give way, and thus set up general peritonitis. In exceptional cases purulent peritonitis becomes chronic, and accumulations of pus burst externally or into the intestines. In rare instances a gelatinous or colloid material constitutes the effusion in peritonitis.

With regard to obvious changes presented by the peritoneum and sub-peritoneal tissue, there may be none when the lymph is separated, the peritoneal surface being normal. In other cases it is dull, lustreless, swollen, and softened, while there is sub-serous œdema, so that the serous covering can be

easily torn off from the organs. When the inflammation tends towards suppuration, the membrane is more lustrous than normal. Occasionally the structures are infiltrated with actual pus; and under certain circumstances localised gangrene occurs at one or more spots.

The microscopic changes and appearances differ in the several conditions indicated, but it must suffice to state that they are similar to those observed in other forms of serous inflammation, namely, transudation from the vessels; migration of corpuscles; separation of, changes in, and proliferation of the endothelial cells; proliferation of the connective-tissue corpuscles; and the formation of vascular granulations. The proportion of cells, and their vitality, differ very much in the several kinds of exudation. The changes which take place in the formation of adhesions and allied conditions are also like those noticed in other serous membranes. *See* SEROUS MEMBRANES, Diseases of.

In certain forms of acute peritonitis foreign materials of different kinds are found in the peritoneal sac. Fœtid gas may be present, either from decomposition of inflammatory products, from transudation through the intestinal walls, or from perforation. The last-mentioned cause also accounts for the presence of foreign bodies, the contents of the stomach or intestine, worms, bile, gall-stones, urine, and other materials which may have set up the peritonitis.

The muscles of the abdominal wall are often found more or less softened, pale, and degenerated in severe cases of peritonitis. The intestines are almost always distended with gas, in some cases to an extreme degree, so that they protrude when the abdomen is opened. Their walls are infiltrated, œdematous, and softened; and the mucous layer can be readily separated. The stomach is usually small and more or less contracted, being covered by the intestines. The liver and spleen are often pale, or discoloured to a slight depth.

The morbid appearances in acute peritonitis may be more or less *general* or *diffuse*, the whole extent of the membrane, however, being rarely involved; or *local* or *circumscribed*, the latter variety being due to some local irritation, and not spreading, either owing to the nature of the inflammation, or because it is prevented by adhesions. It is believed that the omentum often checks the progress of the inflammation from below upwards. Local peritonitis may lead either to a local formation of lymph, as over the liver or some other organ; or to a circumscribed collection of pus, which becomes practically an abscess, and may burst in various directions according to its seat. Abscesses may thus form in the pelvis, iliac fossa, sac of the lesser omentum, either of the hypochondriac regions, the subphrenic region, or in other parts. Gas is sometimes mixed with pus in these cases. Certain local varieties of peritonitis have received special names, such as *pelvic*, *parietal*, *omental*, *hepatic*, *nephritic*, and *vesical*. Most cases of *perityphlitis* are also now looked upon as a form of local peritonitis. *See* PELVIC PERITONITIS; and PERITYPHLITIS.

It must be remarked that special care is required in making a *post-mortem* examination in cases of acute peritonitis, as in many forms of the disease the products are extremely virulent, and cause dangerous or fatal septicæmia if introduced into the system even in the smallest quantity. Moreover, in some forms infection is very liable to be conveyed to other persons, and extreme precautions, even to the extent of avoiding all communication, are demanded in this matter in dealing with women in the puerperal state.

SYMPTOMS.—The fact must be clearly recognised at the outset that the clinical history of acute peritonitis varies considerably in different cases, according to its immediate cause, the condition with which it is associated, its seat and extent, the course which the inflammation takes, the products which it originates, and other circumstances. So far as the peritonitis is concerned, the phenomena to be anticipated are *local* and *general.* The *local* phenomena are due to the inflammatory process itself; to its products; and to its direct effects upon abdominal organs and structures, especially upon muscular tissues, which it first irritates and then paralyses. They may be further subdivided into *abdominal* and *thoracic.* The *general* symptoms are either of a febrile character; or depend upon the absorption of septic matters formed in the peritoneum; or are indicative of collapse. It will be expedient, in further discussing this subject, to indicate first the usual clinical course and phenomena of acute peritonitis; and then to point out the more important clinical varieties of the disease.

The *invasion* is usually distinct, being indicated by shivering or actual rigors, which may be repeated several times. If the peritonitis is due to perforation, however, the phenomena attending this lesion constitute the initial symptoms, but even here rigors not uncommonly occur subsequently. The local and general symptoms characteristic of peritonitis speedily supervene.

Local symptoms.—Pain is one of the most constant and striking symptoms of acute peritonitis, and it comes on very speedily, or in certain cases may even precede the rigors. It depends directly on the inflamed condition of the peritoneum. As a rule, it commences locally, especially in the lower part of the abdomen, but it rapidly spreads more or less extensively, being often felt over the whole abdomen, though not uncommonly more marked in one or more spots, such as

those from which the inflammation started, and also in the umbilical region. The pain is usually exceedingly severe and intense, and may be excruciating or agonising, as evidenced in the expression of the patient's face. In character it is variously described as hot, burning, cutting, boring, shooting, darting, and so on. From time to time exacerbations are liable to occur, owing to spasmodic movements of the intestines disturbing the inflamed structures. Any movement of the body increases the suffering, so that the patient instinctively keeps the trunk at rest, and assumes a characteristic posture, in order to relieve all abdominal tension, namely, lying on the back, with the thighs and knees flexed and the legs drawn well up. Moreover, abdominal respiration is restrained or entirely checked, as the necessary movements increase the pain; which is also aggravated by any such disturbance as the act of coughing, vomiting, or defæcation produces. At the same time there is the most exquisite tenderness, so that the patient dreads any objective examination, and cannot bear the least touch, though deeper pressure is still more unendurable. In some cases even the weight of the bed-clothes cannot be tolerated.

Prominent symptoms occur in connexion with the alimentary canal. The appetite is completely lost, but there is intense thirst. The tongue is furred, and often presents a peculiar appearance, being very small, red, and irritable-looking, while it soon tends towards dryness. The taste is affected, and becomes bitter or otherwise disagreeable, or even disgusting. The breath is also offensive. Nausea and vomiting are usually urgent symptoms, and, as a rule, set in very early. Vomiting occurs when anything whatever is taken, or even spontaneously; while there is often a constant feeling of sickness. At first the vomited matters consist of mucus and altered food; subsequently they present a grass-green appearance; or under certain circumstances may become fæculent, quite apart from intestinal obstruction. Gaseous eructations are also common. Constipation is the rule in acute peritonitis, though it can be overcome by medicines or enemata; but exceptionally diarrhœa occurs, and Dr. Fordyce Barker affirmed that this symptom is more frequent in puerperal peritonitis. At first the intestinal walls are more or less spasmodically contracted, but they soon become paralysed, so that they are distended to a variable degree with gas, and this frequently culminates in extreme tympanites or meteorism. During the development of this symptom, irregular and inefficient peristaltic movements of the bowel often occur, or certain parts are more distended than others; and these conditions may be seen or felt, while they give rise to audible rumbling or gurgling sounds or borborygmi, and aggravate the pain. The rapidity of the distension of the abdomen will depend much upon the previous condition of the abdominal walls, as to whether they are firm or lax and yielding; and upon the rapidity with which their muscles become paralysed.

The only other notable local symptoms in the abdomen are referable to the urinary organs. The urine not only presents febrile characters, but is usually markedly diminished in quantity, and may even be suppressed. What is passed is often hot and scalding. Micturition may at first be very frequent, on account of irritation of the bladder; subsequently retention is liable to occur, owing to paralysis of this organ. The urine is not uncommonly albuminous.

Jaundice is now and then observed in cases of acute peritonitis, and is probably due to some obstruction of the bile-duct.

The *thoracic* symptoms which may result from the local effects of acute peritonitis are hiccough, which is in many instances very distressing; the form of dyspnœa in which the respirations are very hurried—reaching 40, 50, 60, or more, and at the same time shallow, superficial, and upper costal; sometimes cough, although the patient makes every effort to suppress it; and cardiac disturbance, the action of the heart becoming very rapid. The disorder of the respiratory and circulating functions is partly due to the general condition, but they are also locally influenced by the pain accompanying peritonitis; by its direct effects upon the diaphragm; and by the mechanical consequences of gaseous or fluid accumulations upon the diaphragm and thoracic contents. Moreover, morbid conditions within the chest may be associated with peritonitis, such as pleurisy, pneumonia, or pericarditis.

Physical Signs.—The conditions resulting from peritonitis give rise to certain physical signs, which need to be briefly indicated. It must be remembered that in this disease physical examination ought invariably to be practised most gently and cautiously. The causes of the abnormal physical signs are the pain; the distension and disordered movements of the intestines; and the presence of inflammatory products or of other materials in the peritoneal cavity. They may be thus summarised: (1) The abdomen at an early period of the case may be slightly depressed, owing to tension of the muscles; but it speedily becomes more or less enlarged, and often attains a great size, the skin being stretched, and the lower part of the chest also distended. Generally the enlargement is quite symmetrical, but not always. A transverse groove is sometimes visible, passing across the epigastrium. In very muscular individuals the abdomen may be but little enlarged in peritonitis. (2) There is marked absence of diaphragmatic respiratory movements, and these movements as a whole

are restricted. The lower intercostal spaces do not fall in during inspiration. Very rarely a friction-fremitus may be felt over some part of the abdomen if a full breath can be taken. (3) Intestinal movements are often seen or felt for a time. (4) Palpation reveals that the abdomen is smooth and regular; at first the recti and other muscles are felt to become instinctively contracted and rigid when palpation is practised, and the semilunar and transverse markings may even be plainly visible; subsequently the sensation is usually that of more or less tympanitic or drum-like tension. There are exceptional cases in which it is that of a fluid accumulation. (5) Percussion usually yields chiefly a more or less tympanitic sound, though not necessarily uniform in tone and pitch over the entire abdomen. If the tympanites is extreme the sound becomes muffled and toneless. The hepatic dulness and splenic dulness are diminished or completely annulled, even though there be no gas in the peritoneum itself. A small quantity of fluid cannot be detected, or only by careful examination in certain postures (*see* ASCITES), and it is usually hardly worth while in cases of peritonitis to disturb the patient for this purpose. Generally the dulness due to fluid can be elicited in dependent parts of the abdominal cavity, being as a rule distinctly movable with change of posture. It is said that the line of demarcation between the dulness and tympanitic sound is found to be zigzag when carefully percussed out, owing to the fluid getting in between the loops of intestine. In exceptional cases of acute peritonitis the dulness of fluid is the main percussion-sound noticed, or there may be limited areas of dulness, due to local collections. Fluctuation will be present where there is fluid, but it is not a very reliable sign in acute peritonitis. (6) Auscultation, as a rule, merely reveals, if anything, sounds of the movements of flatus in the stomach and intestine; or succussion-sounds, due to the shaking up of fluid and gas in these organs. Friction-sound is for several reasons a rare phenomenon, but may occasionally be heard over some spot if the patient can be made to breathe sufficiently deeply, mainly over a solid organ, and especially the liver. (7) Examination of the chest often reveals more or less compression of the lower parts of the lungs; and displacement of the heart upwards and towards the left.

General symptoms. — Pyrexia usually sets in speedily in acute peritonitis, but in certain cases there is no rise of temperature throughout. While presenting considerable differences, as a rule the temperature rises markedly at an early period—it may be to 104° or 105°—and continues high for a time, though generally with remissions, having, however, no regular course. There are the usual accompaniments of fever; and the urine is markedly febrile, being concentrated, high-coloured, and depositing urates abundantly. The pulse becomes very frequent, reaching 120, 140, or even 160; it is also small, sharp, and often peculiarly hard, wiry, or thready. The increased rapidity of breathing is partly due to pyrexia. It must be noted that elevation of temperature is not always present, even in suppurative peritonitis. The patient soon presents an aspect of serious constitutional disturbance; the expression of the face is one of pain and grave anxiety, and the features appear sunken, pinched, and withered. There is much debility or actual prostration, while at the same time the patient is generally uneasy and restless, tossing the arms about, but keeping the trunk motionless. A more or less cyanotic appearance may be evident. There are usually no prominent nervous symptoms at first, except, perhaps, headache and sleeplessness. The intellect generally remains clear to the last, and it occasionally happens that the supervention of peritonitis rouses a patient whose consciousness has been previously more or less blunted. In exceptional cases delirium and a tendency to stupor are early symptoms. The further progress of the general symptoms will be indicated under the following heading.

COURSE AND TERMINATIONS.—The large majority of cases of acute peritonitis terminate fatally, and usually within a few days, the progress being rapid. It is important to notice that the patient may feel better, and that the pain often diminishes or even subsides, sometimes suddenly, while the general condition is becoming progressively worse. The tympanites may also become less, or disappear. Sometimes before the close an abundance of dark, blood-stained fluid is discharged from the stomach and bowels, without any effort. Death may occur while the pyrexia is still high; but usually the phenomena observed become those of collapse, combined with signs of impaired respiration and stagnant circulation. The patient is greatly prostrated. The countenance assumes more and more the aspect of collapse, the eyeballs appearing sunken and surrounded with dark areolæ, the cheeks hollow, and the features markedly pinched, with blueness of the lips; the expression is that of extreme watchfulness and anxiety. The temperature falls, and often becomes subnormal; the extremities are cold, and the skin is covered with clammy sweats, while the prominent parts are peculiarly cold and blue. The pulse becomes extremely rapid; feeble, sometimes to complete extinction; and irregular. The respirations are very hurried and shallow; and the voice is weak or lost. As already stated, the mind generally remains clear to the last; but in certain cases the mental faculties are some-

what obscured towards the close, and delirium of a low type occurs; occasionally a comatose condition supervenes. In some instances the symptoms become those of the 'typhoid state.'

Acute peritonitis occasionally subsides into a chronic condition, in which localised accumulations of fluid remain, and the patient lingers on, the temperature continuing elevated, but presenting irregularities. Different events may then occur, such as bursting of fluid-collections in various directions, the supervention of septicæmia or pyæmia, or general wasting and anæmia, death ultimately taking place after a variable interval.

Recovery ensues in a certain proportion of cases, where the inflammation has not been extensive, and where its products are either fibrinous or sero-fibrinous. Improvement is indicated by a concomitant diminution of the abdominal symptoms; restoration of the action of the bowels; sometimes an increase in the quantity of urine; a change for the better in the aspect and expression of the patient; increased fulness and force of the pulse, and diminution of its frequency; a gradual fall of temperature; restoration of sleep; and sometimes the occurrence of perspiration. It is said that occasionally a *crisis*, with critical discharges, occurs, but this is quite exceptional, the decline of temperature being usually by *lysis*. After immediate recovery from acute peritonitis the effects of adhesions may prove serious.

Clinical Varieties.—It will only be practicable to indicate here some of the most striking of the clinical variations presented by cases of acute peritonitis. Two special forms are described in separate articles. *See* Puerperal Diseases; and Pelvic Peritonitis.

(*a*) **Peritonitis from Intestinal Obstruction.**—Here the symptoms of the obstruction are the most prominent, and the peritonitis only modifies them, while it helps to hasten the fatal issue, which is mainly due to the intestinal condition. It is in these cases that the movements of the bowels are most evident, and the meteorism is extreme. The temperature may continue normal or even subnormal throughout. The course is usually very rapid.

(*b*) **Perforative.**—When general, this is an intense and very fatal form of peritonitis, which usually runs its course very speedily, especially if highly irritating materials gain access into the peritoneum. Usually it is distinctly preceded by the characteristic symptoms of the perforation; or some condition is present in which a perforation may be anticipated. Therefore, if rigors occur, they in most cases follow a sudden local pain, which spreads rapidly over the abdomen. The local symptoms are extremely marked, and the vomiting is likely to be most violent, except, it is said, in those cases where the stomach itself is the seat of a large perforation. Moreover, there may be signs of gas in the peritoneal cavity (*see* 3. Peritoneum, Gas in). The symptoms of collapse are evident from the first, and, as a rule, quickly increase. The temperature is often below the normal, but there may be more or less febrile reaction. Should the perforation take place into a limited portion of the peritoneum, the symptoms are correspondingly limited and less severe.

(*c*) **Adynamic or Typhoid.**—Cases of peritonitis may be thus grouped which exhibit a disposition to the rapid development of adynamic or typhoid symptoms. These may depend upon the condition with which the peritonitis is associated; or upon septicæmia or pyæmia, arising from the absorption of inflammatory products from the peritoneum. In some of these cases the local symptoms are not so evident, and may be quite latent.

(*d*) **Latent.**—This term implies that the characteristic symptoms of peritonitis are either altogether absent, or so indefinite as to be practically valueless for diagnostic purposes. Such an event may happen in cases belonging to the adynamic group, where the patient's consciousness is so impaired that he cannot feel pain; but even then pressure over the abdomen may bring out indications of tenderness, if carefully watched for. In latent peritonitis the fluid is generally pure pus. For some latent cases of acute peritonitis, of which the writer has seen a striking instance, no explanation can be given. They appear to be frequent in Bright's disease.

(*e*) **Infantile.**—This has been described as a variety of peritonitis. In young infants pain and tenderness in this disease are indicated by the expression, and by a short cry or whine. They do not cry loudly, on account of the pain thus caused. The abdomen is greatly distended with flatus. Vomiting is less common in children than in adults. Pyrexia is usually considerable at an early period; and the pulse becomes extremely frequent, even uncountable. Occasionally convulsions occur. The course is very rapid in young children as a rule.

(*f*) **Local or Circumscribed.**—Cases of localised peritonitis belong practically to two groups. The first includes those in which there is a limited fibrinous exudation —a dry peritonitis—set up by some local irritation, especially in connexion with one of the solid organs, such as a cancerous liver, or with a tumour. Such a condition is only indicated by a correspondingly localised pain and tenderness; with perhaps friction-fremitus and sound, elicited during the respiratory movements. The other local as well as the general symptoms of peritonitis are absent, and the constitution frequently does not appear to suffer in the least. In the second

group a limited effusion occurs, which becomes purulent; or there may be several such effusions. Here the symptoms are more severe, but the pain and tenderness are still circumscribed, and in time external objective signs often appear in the corresponding region of the abdomen, such as limited fulness, a feeling of firmness followed by elasticity or fluctuation, redness of the skin, and dulness on percussion. The more characteristic abdominal symptoms of acute peritonitis are either absent, or much less prominent than usual. The general symptoms, however, are frequently very marked, but they are merely of a febrile character, preceded in many cases by rigors. The subsequent progress of the symptoms will depend upon the course of events. Thus, general peritonitis may be set up; the accumulation may burst externally; a communication may be formed with some internal hollow organ, especially the intestine, when gas finds its way into the space, giving rise to a limited tympanitic sound on percussion, and the fluid is evacuated by the bowel; pyæmia may occur; or the condition may become more or less chronic, and the fluid is ultimately evacuated in some direction or other, or undergoes a caseous change, or is absorbed, a cure resulting, with the formation of fibrous thickening and adhesions. Any organ in the vicinity of localised peritonitis is likely to be disturbed in its functions; and the accumulation of inflammatory products may physically interfere with neighbouring structures. Inflammation of the great omentum is attended with very marked superficial pain and tenderness.

(*g*) **Complicated.**—Clinical varieties of peritonitis not uncommonly result from its associated conditions. Thus it may be modified by some disease to which it is secondary, such as typhoid fever or pyæmia; or it is accompanied by some other affection, such as muco-enteritis, pleurisy, or pericarditis; or the peritonitis gives rise to secondary lesions, which modify the clinical history of particular cases.

Diagnosis.—In well-marked cases the diagnosis of acute peritonitis is sufficiently obvious, as evidenced by the cause of the disease; its mode of onset; the severity and character of the local symptoms; the physical signs; the nature and gravity of the general symptoms; and the rapid progress of the case. More or less difficulty may be experienced when the peritonitis is associated with certain other conditions in the abdomen, modifying its symptoms; when it is obscured by the general state of the patient; when its symptoms are quite latent; or when the disease is local. In some instances it is impossible to distinguish positively between mere ascites and inflammatory effusion. It is very important to bear in mind the conditions in which latent peritonitis is liable to occur, especially Bright's disease. It may happen that the diagnosis of peritonitis is clear enough, but that its cause cannot be discovered, or only after very thorough investigation.

There are certain affections which must be remembered as being liable to simulate, and to be mistaken for, acute peritouitis. (1) The writer has seen cases of extreme tympanites, accompanied with pain, in typhoid fever, and in low febrile diseases, such as erysipelas, very much resembling some forms of peritonitis. (2) Painful conditions of the abdominal wall may prove troublesome, namely, muscular rheumatism, localised inflammatiou, and cutaneous hyperæsthesia. Here, however, although there is superficial and usually diffused pain, with marked tenderness, which may be extreme, there are none of the grave abdominal and general symptoms observed in peritonitis, with the peculiar pulse and other characteristic phenomeua. In connexion with hysteria intense hyperæsthesia of the abdomen is occasionally met with, with more or less distension, sickness, and constipation, and even apparently severe constitutional disturbance, a combination of symptoms which may closely simulate peritonitis. Due care should, however, prevent any mistake in diagnosis, for the patient is generally obviously hysterical; no cause of peritonitis can be discovered; the hyperæsthesia is very superficial, and pressure can be borne if the patient's attention is taken off; while the general symptoms are not really those of peritonitis, and there is little or no pyrexia. (3) Painful affections within the abdomen have to be distinguished from peritonitis. These comprise cramp in the stomach; intestinal colic, including that due to lead; the passage of hepatic or renal calculi; painful affections connected with the female generative organs; and perhaps neuralgia implicating certain abdominal viscera. In mauy of these cases the pain is accompanied with vomiting, frequent pulse, and considerable general disturbauce, tending more or less towards collapse. The history of the case, and the investigatiou of its causes; with the mode of onset and progress of the symptoms, as well as their precise character, ought as a rule to render the diagnosis at once evident. Moreover, the colicky and neuralgic pains are usually relieved by pressure. Doubtful cases must be watched, when any difficulty will probably soon be cleared up. It must be remembered, however, that some of the conditions mentioned may set up local inflammation, and even peritonitis, and thus the diagnosis will be rendered more obscure. (4) Certain objective morbid conditions within the abdomen must also be alluded to in relation to the diagnosis of peritonitis. It may be impossible to distinguish between this complaint and the graver forms of enteritis,

especially that resulting from intestinal obstruction, but the diagnosis is not of practical moment, and the two diseasos are usually combined sooner or later. The positive diagnosis of peritonitis in some cases of perforation may also be impracticable. In certain local forms of inflammation involving the cellular tissue, such as perinephritis and perityphlitis, it cannot be certainly known whether the peritoneum is involved or not; but it may be assumed that the neighbouring portion of the membrane is very soon implicated, and the peritonitis may become general. Possibly circumstances might arise under which accumulations of fluid, such as an ovarian cyst, a hydatid tumour, or a distended bladder, might simulate peritonitis with effusion, but there rarely ought to be any real difficulty in these cases. These conditions, as well as other tumours, may, however, set up peritonitis. A sudden severe pain due to the rupture of an obscure aneurysm in the subperitoneal tissue may be mistaken for perforation and subsequent peritonitis. (5) It must be mentioned that at first acute pleurisy or pneumonia may simulate peritonitis, the pain present in these diseases being referred to the upper part of the abdomen, or even to a more extensive area, and being accompanied with tenderness. In some of these cases, however, the peritoneum itself may be locally inflamed.

Prognosis.—Acute peritonitis must always be regarded as a serious disease, and in many cases the prognosis is extremely grave, or even hopeless. Moreover, its progress, when general, is usually very rapid, so that the patient may die within thirty-six or forty-eight hours, and generally succumbs within a week. Death may occur, however, in three or four weeks, or even at a later period. In some of the cases of very short duration, death is due rather to the cause of the peritonitis, such as intestinal obstruction or perforation, than to the disease itself. The indications affording hope of recovery have already been pointed out, but the practitioner must guard against being misled into giving a hopeful prognosis from mere improvement in the subjective foelings of the patient, without any corresponding amelioration in the objective local symptoms, and in the general condition. Even in cases where recovery takes place, the effects of adhesions and other remaining morbid conditions must be borne in mind, as these may subsequently becomo troublesome or even dangerous.

The prognosis of acuto peritonitis will be materially influenced by the following considerations: (1) *Its ætiology.*—The most grave forms aro those duo to perforation; and those of septic origin, ospecially puorperal peritonitis. That associated with Bright's diseaso and other forms of blood-poisoning is also very serious. When the diseasc arises from direct injury, or from some local irritation, the prognosis is much more hopeful. (2) *The patient.*—In young infants peritonitis is absolutely fatal, and it is extremely grave in children generally. A weak or low condition of the patient, from bad living, intemperance, previous illness, or other causes, renders the prognosis more serious. (3) *The extent, rapidity, and precise nature of the disease.*—Peritonitis is more serious in proportion to its extent; and when it is local the result is much more hopeful, especially if the products of the inflammation seem to be merely lymph or sero-fibrinous fluid, when no particular danger need be anticipated. If the course of the disease is very rapid, the prognosis is exceedingly grave, partly because the inflammatory products are then probably of a low type. When peritonitis shows any tendency to become chronic, there is more hope; but even then a fatal issue may ultimately occur from various causes. (4) *The symptoms.*—It may be stated generally that the more severe the symptoms of peritonitis are as a whole, the more dangerous is the case. Among the chief indications of special danger may be mentioned extreme tympanites; urgent vomiting; the passage of bloody fluid from the stomach or bowels; great dyspnœa; incessant hiccough; very high fever; rapid development of signs of collapse; typhoid symptoms, with low nervous phenomena; and an extremely rapid, feeble, and irregular pulse. (5) *Complications.*—These may increase the gravity of a case of peritonitis, such as pleurisy, pneumonia, or pericarditis.

Treatment.—It will be evident that no uniform plan of treatment can be applicable to all cases of peritonitis, and much judgment and consideration on the part of the practitioner are often needed in the management of this serious disease. There are, however, certain definite indications to be recognised, which will now be pointed out, as well as the principal means by which they should be carried out.

(*a*) Attention must, in the first place, be directed to the cause of the peritonitis, which in obscure cases should be carefully sought for, and, if possible, got rid of or mitigated. This may be illustrated by an accumulation of fæces, hernia, and other forms of intestinal obstruction. In most cases, however, this indication cannot bo fulfilled; but even then attention must bo directed to the cause.

(*b*) Tho next indication is to endeavour to combat tho inflammation itself, so as to arrest or subdue it, to influence its products, and to obviate its injurious effects upon the abdominal organs. Rest for the affected structures is essential, so far as it can be obtained. It will rarely bo necessary to enjoin rest for tho abdomen as a whole, as the pationt usually instinctively attends to this point, and will assume the position already

described. It must be understood, however, that he is to be absolutely confined to bed, and not to be allowed to get up for any purpose whatever. It may be desirable to raise the bed-clothes from the body, by means of a cradle or other suitable apparatus, so as to prevent all disturbance from this source. A pillow may be placed under the knees. If not otherwise indicated, it is extremely important in early cases of peritonitis to give as little as possible in the way of food. Of course, in cases of perforation of the stomach or intestines, nothing whatever must be given by the mouth. In other instances only fragments of ice, or small quantities of iced drinks, should be allowed, or iced milk, beef-tea, or meat-juice, if they can be retained. Not uncommonly the stomach rejects everything, and then recourse may be had to small nutrient enemata or suppositories of artificially digested materials.

Abstraction of blood, either by venesection or by the application of leeches to the abdomen, is a common practice in acute peritonitis. If this measure be thought desirable, it is certainly preferable to remove the blood locally; from ten to thirty leeches may be applied in different cases, but not more. Removal of blood can only be of service in the early stage of the disease, and is decidedly injurious when the inflammatory process has progressed considerably, and especially if it has advanced rapidly. Moreover, it must not be practised in low forms of peritonitis, or if the patient is badly nourished and weak from any cause. Healthy, strong, and plethoric subjects are most likely to be benefited by abstraction of blood. This measure is also useful in some forms of local peritonitis.

The chief medicines which are employed for their immediate effects upon peritonitis are calomel and opium, and they are usually given in combination, in the form of pill, every two to four hours. The calomel is administered until the system is brought under the influence of mercury; or, in the case of infants, this is sometimes effected by inunction with the mercurial ointment. In the writer's opinion, mercurialisation as a routine plan of treatment in peritonitis is to be strongly deprecated, and he has never seen any good result from its employment. Opium, however, is a remedy of extreme value, and is often our sheet-anchor. Amongst other beneficial effects, it acts upon the stomach and bowels, being generally supposed to arrest peristaltic action in the latter, though some are of opinion that it excites peristaltic action but diminishes reflex irritation. In whatever way this drug acts, its beneficial effects upon these organs are very manifest. Opium is usually given in doses of gr. ½ to ij. in the form of pill, and repeated every two to four hours. It is remarkably tolerated in acute peritonitis, unless there be renal disease, when it must be given very cautiously, or not at all. In children it must also be administered with due care. If the stomach is extremely irritable, tincture of opium may be administered in the form of enema; or, which is preferable, morphine may be substituted, especially by subcutaneous injection; and this agent may be also employed as an adjunct to the internal exhibition of opium, if the pain should be very intense. Tincture of aconite, veratrum viride, and digitalis have been employed for their supposed effects in checking inflammation in the early stages of acute peritonitis, but in the writer's opinion they cannot be recommended.

The question of local applications to the abdomen, as regards their immediate effects upon peritonitis, is important, but by no means settled. The common practice is in favour of employing hot applications, in the form of light poultices or fomentations, to which anodynes may be added; or turpentine stupes or sinapisms. The use of cold has, however, been strongly advocated by many authorities in the early stage of peritonitis. It may be employed either by means of cold compresses, frequently changed; a bladder containing pounded ice, not too heavy; or flannels dipped in iced water. The effects claimed for this treatment are that it contracts the vessels; allays nervous irritability, and consequently intestinal disturbance; and alleviates pain. The sensations of the patient must be some guide as to its continuance. At a later period hot applications are decidedly to be preferred, as the cold applications can be of no service, and will probably prove injurious.

(*c*) The general condition of the patient in cases of acute peritonitis always demands constant attention, and in many instances it is the chief matter for consideration. Whenever any tendency to collapse or adynamia sets in, alcoholic stimulants are called for, in variable quantity according to circumstances, brandy and champagne being the most suitable. Their administration must not be left until too late a period. They are best given at frequent intervals in small quantities. If stimulants cannot be borne by the stomach, brandy should be given in enemata. Liquid nourishing food is also often required in large quantities, and may be administered in the same way. Quinine in full doses, ether, musk, camphor, ammonia, bark, and turpentine, are the chief medicines which may be called for in bad cases, to combat the general symptoms. Subcutaneous injection of ether or camphor may be of service in extreme conditions.

(*d*) Symptoms often call for special attention in acute peritonitis, although most of them tend to be alleviated by the measures already considered. It will only be necessary to allude further to the following points. Nausea and vomiting may call for small

doses of iced effervescents, with diluted hydrocyanic acid and morphine; soda-water and milk; or minim doses of creasote. Constipation in most cases ought on no account to be disturbed; if any treatment is indicated, calomel at first, followed by enemata, will answer the purpose. The treatment of certain forms of peritonitis by saline aperients has been advocated, but in the writer's opinion such treatment is most dangerous. Excessive diarrhœa in certain cases may require to be checked by enemata containing laudanum. Meteorism is sometimes relieved by the application of a turpentine stupe, or the administration of calomel in suitable cases; if very troublesome, the use of enemata containing turpentine, the passage of a long tube *per rectum*, or, in extreme cases, the puncture of the distended intestines in several places with a fine trocar, are the measures indicated. Punctures are, however, more dangerous than in tympanites from simple obstruction, as the intestinal coats have lost their elasticity, so that the apertures are inclined to gape, and to allow the escape of fæces into the peritoneum. The relief of this symptom has often a marked effect upon dyspnœa. Hiccough calls for sedatives, ether, the application of sinapisms or blisters to the epigastrium, and, if dangerous, inhalation of chloroform.

(*e*) The question of operative interference in relation to acute peritonitis has now come to occupy a prominent position. In cases of large effusion paracentesis may be decidedly indicated, and in one case under the writer's care this procedure was followed by complete recovery. The more grave operation of opening the abdomen, washing out the peritoneal cavity, and inserting a drainage-tube is also not uncommonly practised at the present day in cases of general peritonitis, especially when it is septic and purulent, and not due to perforation. Accumulations of pus must also be let out, in accordance with the usual surgical principles and methods. For details on these points, the reader must refer to surgical works.

In cases of peritonitis where recovery ensues, much care is required during convalescence, as regards diet and general management; and the removal of unabsorbed morbid products may be aided by applying blisters or iodine to the abdomen, the administration of iodide of potassium, and the employment of baths and other suitable measures.

2. Peritoneum, Chronic Inflammation of.—SYNON.: Chronic Peritonitis.—This affection, like the acute form, may involve the peritoneum more or less generally; or only over a localised and limited area. The conditions included under the term are somewhat indefinite, but not uncommonly they are well-marked pathologically, as well as of considerable clinical importance.

ÆTIOLOGY AND PATHOLOGY. — Without entering into details, it must suffice to point out the circumstances under which chronic peritonitis may occur: (1) There is no doubt as to its being, though rarely, a sequel of one or more attacks of acute or subacute peritonitis, either general or local, but especially the latter; and after a circumscribed acute peritonitis chronic changes may gradually spread more or less widely. Moreover, the conditions remaining after an attack of peritonitis are liable to set up further mischief of a chronic nature. (2) Chronic peritonitis may become associated with ascites, but more particularly when repeated paracentesis has been performed for the relief or cure of this condition. In some of these cases probably the ascites is the result of a simple chronic peritonitis. (3) Localised chronic peritonitis is common as the result of continued irritation, set up by some diseased organ, such as a cirrhotic or cancerous liver, cancer or chronic ulcer of the stomach, old hernias, tumours, and various other obvious conditions. There are, however, cases occasionally observed in which the cause is not so evident, and these have been attributed to irritation by accumulation of fæces, or to repeated pressure or other mechanical causes acting from without. Extensive chronic peritonitis also starts occasionally from a local centre, and especially perihepatitis probably. (4) Morbid formations in the peritoneum itself are very liable to set up chronic inflammation. Of these the principal are tubercle and cancer; and tubercular and cancerous peritonitis constitute important forms of this disease. (5) In rare instances a chronic inflammatory effusion collects in the peritoneal cavity without any obvious cause. The fluid may be actually purulent under these circumstances, but is generally serous, and cannot be distinguished from that of mere ascites. This chronic effusion has been noticed during convalescence from fevers; and has occasionally been attributed to cold and wet. Distinct chronic peritonitis also sometimes occurs as an independent disease, and has then been referred to chronic Bright's disease, alcoholism, gout, rheumatism, lead-poisoning, cardiac disease, and other causes. A case is recorded by Drs. Fagge and Pye-Smith in which the peritoneum, pleuræ, and pericardium were all involved, with the tunica vaginalis, there being chronic effusion, with enormous thickening, but no tubercle or visceral disease.

ANATOMICAL CHARACTERS. — The precise conditions present in an individual case of chronic peritonitis are subject to great variety, as regards their nature, extent, and site; but their general characters can be readily indicated.

Adhesions or fibrous thickenings connected with the serous membrane are almost constantly present in different degrees, and not infrequently they constitute the sole anatomical evidences of chronic peritonitis. They result from the development of the inflammatory products, and the formation of connective or fibrous tissue, with new vessels. The thickening varies much in degree, ranging from what is scarcely perceptible, to the production of a dense fibrous mass an inch or more in thickness, as the writer has seen. It may be evident in the parietal peritoneum; around organs, forming more or less thick and firm capsules; or in the peritoneal folds, especially the omentum and mesentery. Adhesions or agglutinations also form between different parts, thus uniting organs to each other, to the abdominal walls, or to the mesentery or omentum; or sometimes matting the whole together into an inseparable and indistinguishable mass. They present great variety, and by the movements which take place within the abdomen they may be stretched or made looser, or even be got rid of altogether in some instances, when they have formed after an acute attack. On the other hand, in many cases the adhesions and thickenings tend to become gradually stronger and denser, and at the same time to undergo contraction, so that they produce serious effects.

In many cases of chronic peritonitis effusion of some kind is observed. It may be merely a clear straw-coloured serum, or with fibrinous flakes, sero-purulent, or actually purulent. Blood may also be present in it. Occasionally this is the prominent or only anatomical change; and the fluid may range in quantity from a small to an enormous amount. Usually it is associated with the other conditions already described, so that the fluid is not free to move about, and may be actually circumscribed, or even lie in the substance of fibrous masses. Purulent accumulations are likely to make their way in various directions, either outwards or into internal viscera.

When chronic peritonitis depends upon the presence of tubercle, cancer, or other morbid formations, these will be evident on *post-mortem* examination. Moreover, the inflammatory products may undergo degenerative processes, and hence caseous or cretaceous particles or masses be found. Pigment is also often present in abundance.

It is important to notice the obvious effects liable to be produced upon the abdominal organs and other structures by chronic peritonitis. They are more or less fixed by the adhesions and thickenings, and may be displaced at the same time. Compression or constriction is often produced, especially important in the case of hollow viscera, as well as distortion, twisting or torsion, and incarceration. Some of these effects may occur acutely in connexion with bands of adhesion, thus giving rise to grave consequences; and fixation of the bowel may also lead to intussusception. The omentum may be greatly distorted, or contracted and gathered up in some abnormal situation; while the mesentery has been found extremely shortened, so as to contract the small intestine to half its length, its serous covering and longitudinal muscular layer being shrivelled, and its mucous lining thrown into transverse folds. It is said, however, that the small intestines are usually not compressed by adventitious membrane, or even adherent among themselves, though they are contracted in diameter. The deeper tissues of some of the abdominal viscera are likely to be affected by long-continued chronic peritonitis; and atrophy from compression may ensue. The muscular coat of the bowel is generally wasted, but that of the stomach is sometimes much thickened. As one good result of local chronic peritonitis, mention must be made of the fact that it is not uncommonly the means of preventing or modifying the injurious consequences resulting from some forms of perforation of abdominal viscera, by giving rise to previous adhesions and thickenings, and thus obviating the escape of their contents, or limiting their dissemination.

Symptoms.—The clinical history of chronic peritonitis necessarily presents much diversity. The phenomena observed result from the presence of the inflammatory products; the effects produced upon the organs within the abdomen by these products, whether in the way of mere functional disorder, or other more obvious derangements; the consequences of direct pressure upon tubes, vessels, or other structures; and the general or constitutional disturbance often present.

According to its mode of origin, chronic peritonitis either remains after an acute illness, or after a succession of more or less acute or subacute attacks; or its onset is gradual and chronic from the first, and may be very insidious. Of slight adhesions left after acute peritonitis, or originating from chronic causes, there are often no clinical signs; or there may be uneasiness and discomfort, or even painful sensations at times in some part of the abdomen, especially the iliac region, with a tendency to intestinal disorder, in the way of spasmodic movements and constipation. Even when there are no symptoms whatever, adhesions may at any time cause serious consequences. In well-marked cases of chronic peritonitis the symptoms to be expected are of the following nature: Abnormal subjective sensations are usually experienced in the abdomen, such as tightness, fulness, dragging, or actual pain. The pain, when present, is of a dull character, not severe, and liable to come and go, or to present exacerbations from time to time; it is often localised, and especially if the

peritonitis be circumscribed; sometimes there is a feeling of local soreness or heat. The painful sensations tend to be increased by movement, and by shaking the body. They are sometimes aggravated by posture, in some cases by bending forwards, in others by the erect posture; and they may be increased by going up stairs, especially if the abdomen is distended. More or less tenderness on pressure is very common, even when there is no spontaneous pain, but not invariable; it is frequently more evident at certain spots, where it may be considerable. Colicky pains are not uncommon in chronic peritonitis, and may occur in severe paroxysms, especially after food, being due to the disturbed action of the bowels, associated with the production and movements of flatus, which may be abundant, even amounting to tympanites. Appetite is often impaired or variable; and dyspeptic symptoms are frequent. Constipation is the rule, and may be very obstinate, even amounting to obstruction under certain conditions. Sometimes diarrhœa is present, or it may supervene at intervals, and occasionally assumes a dysenteric character. This symptom is very common in tubercular peritonitis, in consequence of the bowel being the seat of ulceration. In some cases vomiting occurs from time to time. When there is considerable effusion in the peritoneum, the secretion of urine is diminished. Respiration may be mechanically interfered with from the same cause. As the result of pressure by fibrous thickenings and other conditions upon different structures, jaundice, ascites, œdema of the legs, thrombosis, albuminuria, or neuralgic pains may supervene. When the organs are all matted together, their entire functions must necessarily be more or less interfered with.

General symptoms are usually present in various degrees in cases of chronic peritonitis, but in many instances they depend mainly upon the condition with which this disease is associated, especially tuberculosis and cancer. These symptoms include pyrexia, not high, and having no regular course, but presenting exacerbations, either persistent or occurring at intervals, and in some cases assuming a hectic character; increased frequency of the pulse; a sense of languor or weakness; and more or less general wasting and anæmia, with dryness and harshness of the skin.

It must be noted that in some cases of chronic peritonitis, even where there is considerable effusion, the local and general symptoms are very slight and indefinite, and the patient only suffers from the discomfort due to the accumulation of fluid. On the other hand, the progress is not uncommonly from bad to worse, ending in extreme emaciation and exhaustion, with the formation of bed-sores; or there may be a succession of improvements and relapses; while various phenomena result from the opening of collections of pus in different directions. Thus death may gradually or rapidly terminate a case; or pyæmia may supervene. Even in bad cases, however, comparative recovery may ensue, only the effects of the inflammation remaining, and being more or less troublesome.

Physical Signs.—These require separate notice, and they may be the only clinical indications of chronic peritonitis. They necessarily differ in detail according to the nature of the abnormal physical conditions present in the abdomen, and are also liable to alter during the progress of a case; but their general characters are sufficiently definite. (1) In general chronic peritonitis enlargement of the abdomen is observed, mainly in proportion to the amount of fluid present; but it depends partly on gas in the intestines, or in certain cases on solid exudation. As a rule, it is not very considerable; but the abdomen may attain an enormous size, with stretching of the skin and other accompanying phenomena. While regular in shape on the whole, it may present more or less want of symmetry, especially after a time. On the other hand, in some cases the abdomen becomes locally or generally retracted, and may then exhibit marked irregularities. (2) The sensations on palpation are very variable, but often highly characteristic. It may happen that there is a uniform feeling of fluid. More commonly the sensations are not uniform, but differ in different parts of the abdomen, including indistinct fluctuation in localised areas, sometimes very limited and in unusual situations; with firmness or resistance around these areas or in other parts, ill-defined, occasionally nodulated; and even distinct tumours may be felt, more or less irregular. These in some instances are due to morbid growths, such as cancer, but they may also originate in organised inflammatory products. Under certain conditions the abdomen yields a peculiar feeling of being movable as a whole. Abnormal movements of the bowels are sometimes recognised. When there are localised adhesions between the visceral and parietal peritoneum, if pressure is made at a little distance from the seat of an adhesion, the skin will rise in a fold where this adhesion exists. Possibly general adhesions might be made out by palpation. (3) Percussion occasionally reveals freely movable fluid. As a rule, however, it shows that the fluid is not freely movable, or that it is actually loculated irregularly, this condition being associated with more or less solid material. Hence there is extensive and diffused dulness, which may be noticed mainly in front, and not in dependent parts. Not uncommonly patches of dulness and tympanitic resonance are found contiguous to each other, and irregularly distributed, unaffected by posture. Over the fluid fluctuation may, perhaps, be elicited,

but indistinctly; and where there is much solid, the sensation on percussion is that of undue resistance. (4) Friction-fremitus and friction-sound are sometimes present. (5) Changes of posture, as a rule, produce comparatively little or no effect upon the shape of the abdomen, the sensations on palpation, or the percussion-sounds.

When chronic peritonitis is localised, it may be practicable to detect the condition by palpation and percussion. Moreover, when certain organs become fixed by peritoneal adhesions, especially if they are diseased at the same time, this state of things may often be recognised by noticing that the affected organ does not present its normal mobility in relation to manipulation and respiratory movements.

Diagnosis.—In most instances chronic peritonitis, if of any extent, can be recognised without much difficulty, by attending to the history of the case, the symptoms, and the physical signs. It may be very difficult, or even impracticable, to distinguish positively between mere ascites and chronic inflammatory effusion. All the circumstances of the case must be taken into consideration; and in doubtful cases the removal of some of the fluid, by means of a small trocar, will aid the diagnosis. It is important to determine the cause of chronic peritonitis, when present, and especially whether it is simple, tubercular, or malignant. Here, again, the whole case must be considered, not forgetting the age of the patient, the family history, and the presence or absence of tubercle or cancer in other parts. It has been said that a hæmorrhagic character of any fluid removed is significant of tubercular peritonitis, but this certainly cannot be relied upon.

It is quite impossible to diagnose with certainty obscure cases of localised chronic peritonitis, though the condition might be suspected; and it may become very difficult, even in evident cases, to determine the precise changes within the abdomen.

Prognosis.—The prognosis of each case of chronic peritonitis must be considered on its own merits, as regards the cause of the disease; its extent and products; the progress of the morbid changes; the effects produced on the abdominal structures; and the general symptoms. Some cases are of little or no consequence; others are very serious; but even in apparently severe cases great improvement, or even practical recovery, may take place. The dangers to be feared from the opening of purulent collections in various directions must be borne in mind; and also those liable to arise from the presence of bands of adhesion within the abdominal cavity. Tubercular and carcinomatous peritonitis are necessarily very grave forms of the disease, but the former may certainly be recovered from.

Treatment.—With regard to the *local* conditions in chronic peritonitis, it is often desirable to endeavour to promote the removal of morbid products within the abdomen. For this purpose it may be important to keep the patient entirely at rest in bed for a time. The internal administration of iodide of potassium or syrup of iodide of iron may be tried; and in some instances diuretics might be of use. Possibly the judicious administration of some mercurial preparation would be serviceable in appropriate cases. Violent purgation is to be deprecated; but where there is much fluid, advantage might be derived from repeated diaphoresis, induced by means of the hot-air, vapour, or Turkish bath, or by the use of jaborandi or pilocarpine. Local measures are in some instances of essential service, namely, counter-irritation, especially by the application of iodine; friction with some oil or ointment; the application of mercury liniment on flannel; and pressure. The writer has found pressure decidedly valuable in aiding absorption in certain cases, as well as in giving support, the abdomen being covered with cotton-wool, and a suitable bandage applied more or less firmly. A flannel bandage answers best. In cases of large effusion, where absorption cannot be effected, the writer has no hesitation in recommending paracentesis, even repeated when required, having seen signal benefit follow this treatment. A localised purulent accumulation must be treated on ordinary surgical principles.

General treatment is often of essential value in cases of chronic peritonitis. It is directed to the condition upon which the disease depends, such as tuberculosis, or to its effects, but the measures are similar in the main, consisting of good nutritious diet, suitable sanitary conditions, change of air, and the administration of cod-liver oil, quinine, preparations of iron, and other tonics and nutrients. Wine may often be given with advantage.

Symptoms will probably need attention from time to time, such as pain, flatulence, dyspeptic disorders, constipation, diarrhœa, and various other disturbances. The organs in general must be looked to, and their functions promoted. A free flow of urine often follows absorption of fluid, or its removal by operation.

There are many cases of chronic peritonitis which need no special treatment, particularly when it has merely caused local changes. For further remarks on the treatment of the tubercular variety, *see* 7. Peritoneum, Morbid Formations and New-Growths in.

8. Peritoneum, Gas in.—Synon.: Pneumoperitoneum; *Tympanites Peritonei.*

Gas may be present in the peritoneal

cavity from three causes, namely: (1) Its escape from the alimentary canal through some rupture or perforation; (2) Transudation of gas through the intestinal wall; (3) Decomposition of morbid materials in the peritoneal sac. The gas may be generally diffused; limited by adhesions; or associated with a collection of pus. The condition cannot be said to give rise to any definite symptoms, except abdominal distension and discomfort. When general it might be recognised by the following *physical signs*: (1) There is extreme and uniform distension of the abdomen, with a specially prominent epigastrium as the patient lies on his back. Sometimes doughy fluctuation is felt in the epigastric region, with a peculiar pitting on pressure. (2) The percussion-sound is markedly tympanitic or even metallic, full and deep in tone; and this sound is very extensive, completely annulling the anterior hepatic and splenic dulness. (3) Succussion splash and sound may be produced, owing to the presence of gas and fluid in the peritoneal sac. These are more uniformly and widely diffused than when such phenomena arise from similar conditions in the stomach or intestines. The aortic sound may also have a metallic quality, and be extensibly audible over the abdomen. A local collection of gas might cause a corresponding fulness of the abdomen, and yield a localised tympanitic or metallic percussion-sound, as well as succussion phenomena if associated with pus.

Prognosis and Treatment. — The *prognosis* and *treatment* of pneumoperitoneum have to be considered in connexion with the several diseases of which it is a part.

4. Peritoneum, Dropsy of. — *See* Ascites.

5. Peritoneum, Hæmorrhage into.— Blood may escape in quantity into the peritoneal cavity as the result of external injury; or from the rupture or perforation of different structures within the abdomen. An important form of hæmorrhage is that which results from the rupture of an aneurysm. More or less blood may be present in inflammatory or dropsical effusion; or it may originate in the opening of vessels by morbid growths, or the spontaneous rupture of new vessels. Peritoneal hæmorrhage is not uncommon in connexion with tubercular and malignant peritonitis. It may also occur from scurvy or purpura. Fatal hæmorrhage has taken place into the peritoneum owing to the rupture of enlarged veins, due to portal obstruction.

Symptoms.—It might possibly happen that peritoneal hæmorrhage could be recognised during life, if there were some evident cause for this condition; followed by the physical signs of the presence of the blood in the peritoneal cavity; and general indications of loss of blood. As a rule, however, the condition cannot be detected clinically. The hæmorrhagic nature of an effusion can only be recognised by withdrawing a portion of it.

Treatment.—This merely consists in the local and general treatment for loss of blood, if anything can be done or is required.

6. Peritoneum, Injuries to.—The peritoneum is liable to be injured from without by contusions and wounds of various kinds; and from within by perforations and ruptures, the injury being aggravated in many cases of this kind by the introduction of matters into the peritoneal cavity, causing mechanical or chemical irritation, or carrying with them septic agents, such as gases, food, fæces, calculi, bile, urine, pus, or worms. The mere injury to the serous membrane itself cannot be said to produce any evident phenomena, unless it be extensive; but it leads usually to serious effects, which have already been considered—namely, hæmorrhage, which may be on a large or fatal scale; and acute inflammation of an aggravated type. Of course, it must be remembered that, along with the injury to the peritoneum, there is usually associated some more or less severe injury to an abdominal organ or other structure, and the phenomena resulting therefrom will be present.

7. Peritoneum, Morbid Formations and New-Growths in.—These require brief notice, and may be considered in the following order:—

(*a*) *Fat.*—It is necessary to call attention to the fact that the sub-peritoneal tissue, especially that of the peritoneal folds, becomes in obese persons the seat of a large *deposit of fat*, an overgrowth of that normally present, and this is particularly noticed in the omentum. As a consequence, the functions of the alimentary canal are unquestionably liable to be interfered with, and various dyspeptic symptoms, flatulence, and constipation may arise. Moreover, this condition assists in producing enlargement of the abdomen; and in muffling the natural tympanitic sound. It can be recognised at once by the appearance of the patient; but it is important to remember that it may conceal some other morbid condition within the abdomen. The treatment is that for obesity generally (*see* Obesity). In very exceptional instances distinct *fatty tumours* have occurred in connexion with the peritoneum; and these may become separated by constriction of their attachments.

(*b*) *Tubercle.*—Tubercle is the most common and important new-growth in connexion with the peritoneum. It occurs in three classes of cases, namely—(1) As a part of general acute tuberculosis, the tubercle appearing in the peritoneum as a diffuse miliary deposit, presenting the usual cha-

racters; (2) As a localised formation, in connexion with tubercular ulcers in the intestines, granulations forming on the corresponding surface of the peritoneum; (3) As a definite local disease, usually assuming a more or less chronic or subacute course, and accompanied with peritonitic changes. The last form is a well-recognised disease of early life, and is then often a part of the condition termed *tabes mesenterica*, being associated with tubercular ulceration of the intestines, and tuberculosis of the mesenteric glands (*see* Mesenteric Glands, Diseases of). Most cases occur under thirty years of age, but the complaint may be met with over fifty. It appears to be much more frequent in males than in females. In the latter it is in the large majority of fatal cases found to be accompanied with tubercular disease of the Fallopian tubes, which is probably set up by extension from the serous surface. In men the epididymis or testis is sometimes affected on one or both sides. The pleuræ are not uncommonly involved, and occasionally the pericardium. Pulmonary tuberculosis is usually present, to which the peritoneal mischief may be secondary, but this is not always so pronounced as to be diagnosed during life, at any rate without careful examination. Tubercular ulceration of the intestines is frequently associated with the peritoneal lesion.

Anatomical Characters.—The morbid conditions found on *post-mortem* examination in pronounced cases of tubercular disease of the peritoneum consist of a combination of disseminated tubercles in different stages, with signs of chronic peritonitis. The tubercles are not uniformly scattered, and are said to be especially numerous on the under surface of the diaphragm and in the flanks, while the surface of the intestines may be comparatively free. They have usually undergone more or less caseation or a fibrous change in different parts. As the result of the peritonitis, great thickening and extensive adhesions are usually present, with much contraction. The omentum is in many cases drawn up into a firm flattened mass across the upper part of the abdomen, below the stomach, and often contains much caseous matter, or recent tubercle. The mesentery is also contracted, drawing the intestines together, and distorting them. The bowels may be completely matted together, and perforated by tubercular ulcers at different points. More or less effusion is almost always present, consisting of turbid serum or pus; and it often contains altered blood in variable quantity. Sometimes abundant hæmorrhage takes place into the peritoneum. The effusion is frequently localised by adhesions at different points; or it may be ultimately removed altogether, and only adhesions left.

Symptoms.—The clinical phenomena present considerable variety in different cases, as regards their nature and progress. In some instances tubercular disease of the peritoneum begins acutely, or in a succession of acute attacks, usually circumscribed, with symptoms like those of peritonitis, then subsiding into a chronic condition. Far more commonly the progress is subacute or chronic and insidious, or even latent for a time. In other cases there are marked remissions of the symptoms during their progress, both local and general. The phenomena may be summarised as those of the peritoneal inflammation already described, and the presence of firm lumps in the abdomen, mainly revealed by physical examination; with general symptoms of tuberculosis, usually in a pronounced degree; and often signs of implication of other important organs and structures in the tubercular process. The detection of the great omentum, which is felt as a rounded mass, extending more or less obliquely across the upper part of the abdomen, is highly significant in the diagnosis of tubercular disease of the peritoneum. In some cases there is firm thickening, with redness and soreness, around the umbilicus, which is usually due to extension of inflammation from the peritoneum along the obliterated umbilical vessels to the surface. Occasionally the umbilicus has given way, and a discharge of pus has taken place from the peritoneal cavity. Tubercular peritonitis is usually chronic in its progress. It is a serious disease, but is not so fatal as was formerly supposed, especially in young subjects, and when treated in accordance with modern views.

Treatment.—The general measures suitable for tubercular disease must be carried out, as well as those already indicated for chronic peritonitis. Dr. Wilks recommends the administration of iodide of potassium, with or without quinine, and inunction over the abdomen with liniment of mercury, followed by the application of tincture of iodine. Operative treatment is now fully recognised as a means of cure in suitable cases of tubercular peritonitis. The writer has seen recovery follow paracentesis for a large effusion in a case undoubtedly tubercular. The method usually practised, however, is to open the abdomen, wash out the peritoneal cavity, and drain it. For details, reference must be made to surgical works.

(*c*) *Cancer.*—Cancer is comparatively rare in the peritoneum. It is by far most commonly secondary, originating from extension, or as a distinct secondary formation; and chiefly following malignant disease of the alimentary canal, especially the stomach, liver, pancreas, retro-peritoneal glands, and female generative organs, particularly the ovary. It can extend from one serous surface to another without the formation of adhesions. Rarely this disease is primary, and has then been referred to injury in some instances. The writer has recently

met with a case in which peritoneal cancer seemed to be primary. It is very rare under thirty, but has been observed even in childhood. Most cases occur between fifty and sixty. The disease is much more common in females than in males.

Peritoneal cancer is generally of the scirrhous type, but is occasionally encephaloid, melanotic, or colloid, the last being comparatively frequently found here, and it may form an enormous mass. Virchow believes that the growths are often sarcomatous. Rarely the disease assumes an acute character, the cancer being in diffused nodules. Usually chronic, it either takes the form of separate nodules, which are often umbilicated; or of an infiltration, sometimes of great thickness. Probably this appearance is due to an aggregation of nodules. Each nodule may send out processes, which tend to pucker and drag the neighbouring part of the peritoneum to it as a centre. The distribution of the nodules is very variable. They are usually far more abundant in the flanks and over the diaphragm than elsewhere. The omentum may be drawn up into a solid mass, as in tubercular disease. Generally there are associated signs of chronic peritonitis, with more or less effusion, which is often hæmorrhagic; extensive hæmorrhages sometimes take place. Abdominal organs are usually found implicated; or the cancerous process may lead to their destruction or perforation. In some instances there is a large dropsical effusion in the peritoneal cavity.

Symptoms and Diagnosis.—The clinical phenomena in different cases of peritoneal cancer are very variable in their exact nature, but their general characters may be readily understood. At first the disease will probably be obscure, and the symptoms indefinite. Abdominal pain is commonly complained of, and is often increased paroxysmally from intestinal disorder; tenderness here and there is also generally marked. There may be signs of more or less disturbance of abdominal organs, or one or other of these is in most instances also the seat of disease. Cancerous growths in the peritoneum tend to interfere considerably with the alimentary canal, and by their contraction and puckering may cause marked narrowing of the intestinal tract, or even give rise to ileus. They may produce other symptoms by pressure on various structures. Ascites is a very frequent symptom; and jaundice sometimes occurs. Physical examination will reveal signs of the growth itself; of chronic peritonitis; and of ascites. Cancerous nodules may originate friction-sounds. In some instances a hard thickening or mass is evident in the tissues around the umbilicus, which may also look red and inflamed, as in a case recently under the care of the writer. If fluid is withdrawn from the peritoneal cavity, it is usually more or less mixed with blood; and marked anæmia or fainting may result from hæmorrhage. The general symptoms and cachexia of cancer become pronounced during the progress of the disease. Its course is occasionally somewhat acute, with pyrexia; as a rule, it is more or less chronic, with little or no fever, or this only occurs at intervals. The termination is necessarily invariably fatal.

It is necessary to offer a few separate remarks about *colloid* involving the peritoneum. This condition is attributed to a colloid degeneration of a carcinoma. All the abdominal viscera may be enveloped in thick layers, consisting of round gelatinous masses. Many of these are attached only by the most delicate threads, or even seem to be free. It is a very rare disease, but when present in a marked form is, according to the writer's limited experience of it, easily recognised clinically by the following physical signs: (1) The abdomen is greatly and may be enormously enlarged, but is not quite uniform or symmetrical; the umbilicus is only stretched, not everted. (2) Palpation generally reveals a feeling of resistance, with rather firm, irregular masses. Fluctuation is either absent or very indistinct. (3) There is extensive dulness, with resistance, over the abdomen, the anterior regions being markedly dull, and there being no indications of accumulation of fluid specially in the flanks. (4) Usually a change of posture produces little or no effect upon the physical signs. (5) A slimy gelatinous fluid may possibly be removed by the exploratory needle or aspirator; and occasionally a similar fluid is said to be discharged *per rectum*, or from the stomach.

Treatment.—Nothing can be done in cases of malignant disease of the peritoneum, except to treat symptoms.

(*d*) *Rare formations.*—Among rare formations found in the peritoneum may be mentioned hydatids, associated or not with a similar disease in one or more organs; serous, dermoid, and colloid cysts; fibromata; myxomata; and remains of blood-clots.

8. Peritoneum, Malformations of.—It will suffice to mention under this head that the folds of the peritoneum, such as the mesentery, may be abnormal in length or formation; that unusual bands or openings may be present; and that prolongations of the peritoneum, which naturally become obliterated or shut out from the general cavity, sometimes do not undergo these changes, as may be illustrated by the occasional patency of the process of the serous membrane which descends with the testis into the scrotum. As the result of these abnormalities, displacements of organs may occur; or their movements are restricted or too free; or constriction of the intestine may take place. These conditions can only be recognised

clinically by their effects; and not uncommonly they cannot be made out. Treatment may sometimes be directed to their cure, as is exemplified in the radical cure of a congenital hernia.

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PERITYPHLITIS (περί, around; and τυφλόν, the cæcum).—SYNON.: Fr. *Pérityphlite*; *Phlegmon iliaque*; Ger. *Perityphlitis.*

DEFINITION.—By perityphlitis is understood a peritonitis localised to the region of the cæcum. The clinical phenomena represented by this form of peritonitis have been included under such terms as *typhlitis, paratyphlitis*, and *inflammation of the vermiform appendix.* Typhlitis was formerly considered to indicate especially an inflammation of the cæcum itself, and paratyphlitis to be applicable to an inflammation of the connective tissue which was at one time erroneously supposed to invest the cæcum behind. The term 'perityphlitis' does not concern itself with the seat of origin of the trouble, but indicates with sufficient clearness the predominant pathological feature of an affection which may arise in many ways, and which has no precise clinical individuality until the peritoneum in the cæcal region has become inflamed.

NORMAL ANATOMY.—The cæcum is that part of the large intestine which lies below the level of the ileo-cæcal valve, that is to say, below the point of entrance of the ileum. The average breadth of the adult cæcum is three inches, and the average length two and a quarter inches. The cæcum is always entirely covered by peritoneum, and is never attached by areolar tissue to the iliac fascia. It is usually found lying upon the psoas muscle, and so placed that its apex just projects beyond the inner border of that muscle, and corresponds with a point a little to the inner side of the middle of Poupart's ligament. In exceptional instances the cæcum may be found within the pelvic cavity, or even to have passed to the left of the median line. In examples of imperfect descent of the caput coli this part of the bowel may be met with close beneath the liver or high up in the right loin. The average length of the vermiform appendix is three inches, and in the majority of instances the process is found twisted upon itself. This spiral disposition depends mainly upon the shortness of its mesentery. In the adult body the appendix will usually be found to lie behind the end of the ileum and its mesentery, and to point in the direction of the spleen. Another position which is not infrequent is a vertical position behind the cæcum. The process may occupy the pelvis, and may be found in contact with the sigmoid flexure, rectum, uterus, or bladder.

ÆTIOLOGY.—Perityphlitis has been noticed to follow an exposure to cold, and also after violent exercise, but it is very doubtful whether either of these circumstances alone could be responsible for the attack, though very possibly they are effective accessories to any of the pathological conditions to be presently mentioned. Injury to the cæcum from blows, &c., might set up the disease, and even produce a chronic inflammation with progressive ulceration of the structures in the iliac fossa. Formerly it was usual to attribute many cases of perityphlitis to rheumatism, but with an extended knowledge of its real causation there seems no good grounds now for such an idea.

The important predisposing causes, however, are to be found in sex and age. By far the larger proportion of cases—some say even three-fourths—are males, although in the milder cases associated with extreme constipation this preponderance is not, in our experience, so marked. It has been estimated that 33 per cent. of the cases occur between the ages of twenty-one and thirty, and 30 per cent. between eleven and twenty years, the remainder being distributed over younger and older ages than these; the malady therefore is mainly incidental to childhood and early adult life.

ANATOMICAL CHARACTERS AND PATHOLOGY. 1. Perityphlitis may originate in the *cæcum.* In such rare instances an ulcer of the mucous membrane has probably been produced by the mechanical and chemical irritation of impacted fæcal matter, or by the lodgment of a foreign substance. The ulcer has extended in depth until an inflammation of the peritoneum has been induced. This condition is not often met with in the *post-mortem* examination of fatal cases, but it has been demonstrated during the progress of an operation for perityphlitis. Perforation of the cæcum, and consequent perityphlitis, has been produced by a tubercular ulcer, and more rarely by a dysenteric or even typhoid lesion. Epithelioma of the cæcum which has perforated has also been known to cause the symptoms of perityphlitis.

2. The disease may start from the *vermiform appendix.* The process may become so twisted upon itself, owing to the scantiness of its mesentery, that its lumen is occluded. Mucus may collect behind the point of blocking, and the distal part of the process, becoming distended thereby, may form a large and firm swelling. In this distended part of the appendix suppuration may occur, and perforation follow. Severe perityphlitis, regarded clinically, may be met with in cases in which the appendix has not given way, and in which no pus has been produced within its lumen. (*See* series of cases, *Brit. Med. Journ.* April 22, 1893.) On the other hand, as a result of torsion, the vessels may be compressed and the appendix may become wholly gangrenous, or it may be found in cases which have recovered to present the appear-

ance of having been cut into two or three pieces. In another series of cases a foreign body in the appendix has been the cause of an acute inflammation of the process, or of a perforative peritonitis about it. Such bodies have included seeds, grape-stones, cherry-stones, bristles, pins, shot, minute gall-stones, and the like. Foreign bodies of this class may be expected to be the cause of the perityphlitis in about one-eighth of the cases. In more than one-third of the instances of perityphlitis, as revealed by *post-mortem* records, a concretion has been discovered. The salts forming these little bodies are derived from the mucus secreted by the appendix. There is often as a nucleus a minute foreign body. It is probable that the formation of these concretions is preceded by some disturbance of the blood-supply, whereby the mucous membrane is irritated and a chronic catarrh is maintained. In 146 cases of perforation of the appendix collected by Matterstock a concretion was found in sixty-three instances, and a foreign body in nine. In the remaining examples it may be concluded that the trouble took origin in the walls of the appendix itself.

As a result of repeated attacks of inflammation, the appendix may become obliterated, and the total effacement of the process may occur without suppuration having taken place.

Among the least common causes of perityphlitis may be mentioned actinomycosis of the appendix, and tubercular ulceration of that part.

A *perityphlitic abscess* is primarily intraperitoneal, and is an encysted form of suppurative peritonitis. In the majority of instances the centre of the abscess is behind the cæcum. The contained pus is sometimes of wholesome appearance and free from offensive odour. In the larger proportion of the cases, however, it has a distinctly fæcal smell, a circumstance which attends most abscesses in connexion with the lower bowel, and which does not of necessity imply that the contents of the intestine have escaped into the abscess cavity. In the minority of the examples the abscess does contain fæcal matter, and the lumen of the intestinal canal is opened up. The fæcal material may have escaped through a rent in the appendix, or may have followed gangrene of that process, or, less often, may have made its way through an aperture in the cæcum. This perforation may have proceeded from within outwards, but more usually it is due to the bursting into the cæcum of an abscess which had commenced outside the caput coli. The direction in which the abscess tends to burst is illustrated by sixty-seven cases collected by Bull. In twenty-eight instances it burst through the anterior abdominal parietes; in fifteen it entered the cæcum; in eight the general peritoneal cavity; and in two instances each it made its way respectively into the thorax, the rectum, and the bladder. The abscess often shows a tendency to extend upwards behind or along the ascending colon, and it is by this route that the thorax has been reached and an empyema produced. The abscess, when it extends to the pelvis, may pursue the course of any other pelvic abscess, and may thus make its way out into the buttock and perinæum, and may even extend down the thigh. The comparative frequency with which a suppurative collection started by disease in the appendix may make its way into the cæcum has given rise to an exaggerated and erroneous idea of the frequency with which the cæcum is primarily involved in these cases. Suppurative pylephlebitis may be met with in association with perityphlitis. *See* APPENDIX.

SYMPTOMS AND COURSE.—The signs and symptoms which are associated with the structural changes just described, and determined by the causes just indicated, exhibit a marked variety in mode of onset, course, severity, and duration; so much so that descriptions of extreme cases are scarcely recognisable at first as pertaining to what we regard as the same disease. It is also probable that the clinical application of the term 'perityphlitis' is of somewhat wider range than its pathological significance as here defined; there are many cases, for instance, commonly so designated, in which an actual peritonitis is of doubtful existence. The exact relation of the clinical conditions observed to the existing anatomical changes is sometimes uncertain, more especially in the milder cases which end in complete recovery, and cannot be investigated *post mortem*.

Three well-marked groups may be recognised, to one or other of which most cases may be referred, though occasionally the disease runs a course which cannot be exactly included within one of these types.

(*a*) In the first group will be found those cases which, occurring in apparently healthy persons, or with but very little and unimportant previous symptoms, run an exceedingly rapid course of a few hours, death resulting at the outside within two days. Here the symptoms are mainly those of perforation of the intestine, with very little indication of the seat of the lesion. The patient is suddenly attacked with severe abdominal pain, by no means necessarily felt in the neighbourhood of the cæcum, but often about the umbilicus, followed by all the symptoms of collapse, which may be very soon fatal (*see* INTESTINES, Diseases of: 21. Intestines, Perforation and Rupture of). The necropsy reveals perforation of the vermiform appendix or very exceptionally of the cæcum, and some degree of localised peritonitis.

(*b*) The onset of the symptoms in the next group also takes place as a rule without any history of previous discomfort, constipa-

tion, or illness; and whilst less rapid than in the preceding, they are usually well marked. Often commencing with a chill or rigor, these cases are also characterised by acute pain, indifferently referred to the belly generally, or perhaps specially to the umbilical or cæcal region. The pain may cause a moderate degree of collapse, but not nearly so severe as that associated with acute perforation, which we may surmise in the cases under consideration has not yet actually taken place; or, if it have occurred, its effects are strictly confined to the immediately adjacent region. With the pain, which becomes paroxysmal and often radiating to the testis, pudendum, thigh, or bladder, there is considerable tenderness, which may be distinctly limited to the right iliac region, and thereby becomes an important factor in the diagnosis. Other signs of localised peritonitis quickly supervene: the abdomen becomes distended and tympanitic; and occasionally, if the tenderness do not prevent, a slightly increased resistance is perceptible over the cæcum, due in part to the rigidity of the abdominal muscles, and partly perhaps to retained fæces in the cæcum, or inflammatory effusion around that structure. The temperature rises two or three degrees, or even to 104° or 105° F.; the pulse is frequent and thready; respirations are quickened; and the aspect of the patient is that of severe illness. There is constipation; often severe tenesmus; and vomiting, which may be mild and only excited by food, or of a bilious character, but its occurrence is not followed by any sensation of relief. The tongue is thickly coated, or dry brown and cracked, with sordes on the teeth. Some observers have noted a very abundant flow of urine, which contains an excess of indican; and frequency of micturition. The patient may remain in much the same state for two or three days, when the pain and tenderness spread over the abdomen. The legs are drawn up and the arms raised above the head so as to relax the parietes and increase the capacity of the abdominal cavity; and with an intensification of the above symptoms there exist all the evidences of general peritonitis, from which the patient may succumb within the next few days, though recovery even at this stage is not quite unknown. Or the inflammation may assume a distinctly suppurative character, leading to the formation of a large quantity of pus encysted within the peritoneal cavity in the cæcal region, giving rise to an increasing fulness and resistance, which may be detected through the abdominal wall, or sometimes by rectal or vaginal examination. The abscess thus formed may extend, and burst in one or other of the directions already indicated. On the abdomen being opened, either by the surgeon or *post mortem*, the mischief is seen to have started from ulceration and perforation of the appendix; and these cases only differ from those in the former group in degree of severity and rapidity, their longer duration affording the opportunity for the development of additional symptoms. It may be observed that cases of this severe type do occasionally begin with mild symptoms such as characterise the following group, or the graver manifestations may be delayed in their occurrence; but it is estimated that 68 per cent. of the fatal cases die within eight days.

(*c*) The third class of cases—certainly the most numerous—include those which are much less severe in their character, more prolonged in duration, and generally recover. Contrary to what obtains in the previous groups, the patients are more frequently women, and a previous history of constipation, often excessive, is the general rule. After perhaps a more than usually obstinate confinement of the bowels, or some gross error in diet, such as eating a very large quantity of nuts, the patient complains of very definite pain over the cæcum, which is found to be tender, swollen, resistant, and dull on percussion, due to fæcal accumulation. It is the prominence of the local symptoms which specially characterises this class of cases, the seat of the trouble being obvious from the commencement. There is also a moderate and very irregular rise of temperature, rarely exceeding 103° F., with soft quick pulse, and general febrile symptoms. The constipation persists, owing to the arrested peristalsis from inflammation of the bowels; and nausea or vomiting is of frequent occurrence, though not often very severe. It is in these patients that is commonly noticed the drawing-up of the right leg, which is flexed across the other thigh, so as to relieve as far as possible the pressure of the abdominal wall on the swollen region. The pain continues of a dull aching character, now and then with sharper twinges, and often spreads across the lower part of the abdomen, and suggests an extension of the peritonitis, though it is doubtful whether this is really the case; it also shows a great tendency to pass down the inner and anterior surface of the right thigh, due to pressure on the genito-crural nerve. Sometimes there is œdema of the right leg, from thrombosis of the iliac vein induced by pressure. The duration of these cases is very uncertain, and much depends on their treatment; some last but a few days, others may continue for two or even three weeks, varying much in the severity of the symptoms, for some days the patient being gravely ill and then appearing considerably better, fluctuating from day to day. The extent of the swelling and dulness is frequently changing, as also to a less degree the pain and general symptoms. A small proportion of the cases which run the course described end in suppuration, and the formation of a circumscribed abscess, such as occurs in the former

group; but the greater majority end in resolution and complete cure. How far the appendix is concerned in these cases is doubtful, and certainly it is unlikely that gross lesions of that structure occur in any but the few which suppurate; nevertheless it has been shown that very mild perityphlitis does follow disease of the appendix, and may end in perfect recovery, and also that suppuration does not always occur even when severe disease of that organ exists. It is probable that in certain of these milder cases the cæcum is more at fault, being in a state of inflammation and probable ulceration, determined by the irritation of the hardened fæces, and that it is a true typhlitis—the *stercoral typhlitis* of writers—the well-defined swelling being partly formed by the thickened wall of the inflamed bowel, with perhaps some peritonitis, and still more by the retained intestinal contents.

Relapsing perityphlitis.—A marked characteristic of the morbid state under consideration is its liability to relapse—11 per cent. of the cases are estimated to do so. A slight indiscretion in diet may be sufficient to reinduce it, and it may recur from this cause again and again; or it may be that the patient has got about before the attack has completely subsided; or in many cases relapse may occur when every care has been taken, and successive recurrences are likely to be of increasing severity. When suppuration has taken place as a result of perforation of the appendix and escape of the original irritant, concretion, or foreign body in the discharge from the abscess, recurrence is not so likely to happen; but so long as it remains it is an ever-present source of danger; nor will there be relapses if the appendix have become gangrenous and separated. The exciting causes of these relapses may be found in the condition of the appendix itself, which by becoming twisted or bent on itself, fixed by adhesion, or stenosed by a cicatrix of an old ulcer, permits an accumulation of mucus within it, and consequent distension of its distal end; this condition is sufficient to set up a localised peritonitis, which recurs until the pseudo-cyst is emptied, and the lumen of the process finally and completely occluded. The attacks which form the third group of cases above described, which are closely associated with fæcal retention, are also likely to be repeated unless the bowels are kept regularly and thoroughly opened. The liability to some accumulation taking place, even when there is a daily evacuation, is not to be forgotten.

Diagnosis.—The condition known as perityphlitis requires to be distinguished from several other intestinal affections. In ileocæcal invagination, which may give rise to many of the symptoms above described, the evidences of obstruction rather than of peritonitis predominate, the pain is more acute, and vomiting is usually more severe and persistent, whilst the stools contain bloody mucus; tenesmus also in these cases is much more marked. Other forms of acute intestinal obstruction may be mistaken for it, and often cannot be distinguished; the presence of distinct swelling, dulness, tenderness, and pain restricted to an area in the iliac fossa are of primary importance in determining the case to be perityphlitic. Occasional cases of enteric fever, where there is constipation and absence of rash, may be confused with the malady under consideration, especially as the neighbourhood of the cæcum is the situation where the most distinct signs occur in both diseases; but the history, the course of the fever, and the characteristic tongue and general appearance of the patient in typhoid fever, together with the sequence of headache and delirium and splenic enlargement, should afford grounds for discrimination. Less often may tubercular peritonitis need to be separated, but here again the history, temperature, and coincidence of other evidences of tubercle elsewhere must be considered. Suppuration in connexion with the ovary, or behind the peritoneum from caries of bone, perinephritic abscess, &c., may simulate the fæcal abscess following perityphlitis.

Prognosis.—Much difference exists in this respect among different cases. Those which may be comprised within the third of the foregoing groups should be expected to recover. The mortality among the severe cases described in the first and second groups has been estimated at 30 per cent. in adults and at even a higher rate in children. The course and termination of cases attended with constipation are less favourable.

But, beside those cases which end in death or recovery, a few may continue for months or years suffering from some of the effects of the disease, such as chronic peritonitis, chronic diarrhœa, fistulæ. The frequency of relapse has been alluded to.

Treatment.—This must obviously differ very considerably according to the severity of the case, and may conveniently be considered according as operative interference is or is not called for.

When the disease is distinctly associated with fæcal impaction, and when the symptoms are milder and somewhat more prolonged in duration, recovery is to be expected without operation, although, as said, occasionally an abscess forms, which may require to be opened. For such patients as would be included within the third of the above described groups, rest is essential, and the treatment consists in a judicious application of means to remove the contents of the cæcum, together with such an amount of sedative as will serve to keep the parts concerned as quiet as is consistent with the

necessary evacuation. To meet the first indication enemas of plain water or soap and water are the most satisfactory. They should not be too large—fifteen to twenty ounces for an adult—and should be repeated, but not too frequently; it is rarely desirable for the enema to be given more than once in the day, and every other day is usually often enough. Much harm may be done by inducing a violent evacuation, though there may be a large quantity to be removed, and it is far better for this to be effected gradually. Some advise, in addition, frequent small doses—twenty grains—of sulphate of magnesium or sodium, not with a view of direct purgation, but to induce a moderate intestinal secretion, whereby the hardened fæces may be somewhat softened. Anything in the nature of a violent aperient is strongly to be deprecated, and it is better to give occasional doses of opium, gr. ½ to i, by the mouth, whereby pain is relieved and the risk of peritonitis appears to be diminished. For the same object, three or four leeches applied over the cæcum are most effective; or hot fomentations, either made with poppy-heads, or applied after the surface of the abdomen has been painted with extract of belladonna and glycerine. The diet should be restricted in amount as much as possible: there is usually anorexia, and abstinence from food is beneficial; occasional teaspoonfuls of meat-juices, and a few ounces of peptonised food are amply sufficient as a rule, and stimulants are very rarely needed. It cannot be too strongly insisted upon that the patient should be kept in bed, even for some days after complete cessation of all symptoms, as a very little exertion or slight excess of food may be sufficient to induce a relapse.

If the symptoms persist, if the temperature keep high, and if the local phenomena become more prominent, then an incision over the swelling will be called for. It is seldom until after the fifth day that surgical interference is demanded. In the cases dealt with by the surgeon the dulness will have increased, the local tenderness will be more marked, and possibly redness of the skin and œdema may indicate the importance of immediate treatment.

In some cases which have been allowed to progress, all the clinical evidences of abscess are present.

The treatment of cases of the first group is identical with that followed in instances of acute perforative peritonitis. A prompt abdominal section offers practically the only prospect of saving life.

In dealing with cases of the second group, the general measures already described are employed. If the local and general symptoms persist, an incision will be called for. This, as already stated, is seldom indicated before the fifth day.

In cases of relapsing typhlitis, the operation for the removal of the appendix may be called for when the attacks are severe or are increasing in severity, when the attacks are becoming very numerous, when the last attack has been of an alarming character, or when the repeated illnesses to which the patient is rendered liable are undermining his health, or interfering with the pursuit of his calling.

In any case in which this operation is undertaken, it may be assumed that the enlarged appendix can be made out after the acute symptoms have subsided. The removal of the offending appendix should be carried out during the period of quiescence, and after all the usual symptoms of perityphlitis have disappeared.

It may perhaps be said that the danger of the operation is no greater than that attending another attack. W. H. ALLCHIN.
FREDERICK TREVES.

PERI-UTERINE HÆMATOCELE. *See* PELVIC HÆMATOCELE.

PERSONAL HEALTH. — Personal hygiene is the science of individual health. As there are public acts and laws which, observed, promote the health of communities, so there are rules of living and habits of life, inculcated by competent observers, by attention to which the health of the individual may be preserved or increased. Health is a quality of body easily comprehensible, but difficult to define. It is dealt out in different measures at different periods of life, and is perhaps best described as exemption from disease. It admits, however, of being estimated, and we shall first show how this may be done.

First, the form of the individual must be examined to ascertain how far it agrees with or departs from certain mean standards, such as are laid down by anatomists and practical hygienists, and which give, in tables for each age, what the height, weight, girth of chest, and mobility of thorax ought to be every year of life. Thus above the weight of 161 lbs. avoirdupois, the circumference of the chest ought to increase 1 inch for every 10 lbs. of additional weight; and for every inch in height over 5 feet 8 inches the mobility of the thorax ought to increase in a definite ratio (*see* Parkes's *Hygiene*, p. 480). Then the girth-measurement, taken round the mamma, should be in excess of that taken lower down, at the level of the xiphoid cartilage, in every man, although not disproportionately so, as it is in women who lace tightly.

Secondly, the manner in which the various functions of the body are performed must be ascertained. The situation of the heart's apex-beat is to be determined; its impulse; its mode of action; the rhythm of its sounds; the way in which the circulation is being

carried out; how temperature is maintained at the extremities; and what individual capacity exists to resist conditions calculated to lower the body temperature. The respiratory, cerebral, and spinal functions must be tested; the organs of digestion, sanguification, and excretion, as well as their performances, will have to be examined in due order; and the state of general nutrition and the condition of the skin appraised.

That state of body which enables it to perform every function which can be reasonably required of it, to accomplish each ordinary task, and be equal to some exertion of brain and muscle without painful sense of fatigue, is what we ordinarily understand as health. It would be difficult, however, if not impossible, to lay down the amount of work or exertion, short of positive fatigue, which a child, lad, woman, or man ought to be equal to without preparation or training of any kind. Erectness, firmness, good balance of body and mind, testify to a man, as they do to a racehorse or a gamecock. An experienced eye recognises at a glance the particular build of man suitable to particular taskwork; likely to excel in particular exercises, sports, or games; fitted to labour with his head, or with his hands; to run, swim, or fight well. There is, perhaps, a little less difference between man and man than between carthorses and racehorses, but it is one of degree only. *Fortes creantur fortibus*, and for perfect bodily aptitude for any trade, profession, or particular craft, the individual must be born, bred, and trained accordingly. We arrive at the following signs or evidences of health: (*a*) good construction; (*b*) accommodativeness to change, individual adaptability to widely diverse conditions of life, or of climate, without deterioration of energy; (*c*) endurance; (*d*) self-control — mental, emotional, sexual; and (*e*) resistance to morbific influences.

From birth onwards to old age, health is not uniform; it varies as the body varies, according to wear and tear, and treatment—a sufficiently obvious proposition. At different epochs of life the strain or stress is felt in different parts, falls upon different organs, and issues in proclivity to disorder of their several functions, or in wear or degeneration of the tissues of which they are built. Our object here is to demonstrate how personal health may be secured; how disease may be avoided, or diminished; and how the days of ailing, of sickness, of incapacity to follow one's work or ordinary pursuits can be diminished; how the active, energetic period of life may be extended, the ageing of the body deferred, its happiness or *bien être* promoted. To fulfil this endeavour, we divide the life of a human being into the following periods, and consider them separately in relation to their special physiology, to morbid imminences, and to probable accidents, laying down the best rules of guidance in diet, clothing, habits, exercise of body and mind; indicating whatever appears most conducive to the health of the individual at the age mentioned. It is of course of first importance to be born of a healthy, long-lived stock; but for heredity and its effects the reader is referred to the articles, DISEASE, Causes of; and HEREDITY.

LIFE PERIODS.—The following are the periods of life, as they will be here successively considered:—

1. **Intra-uterine life and Gestation.**
2. **Birth.**
3. **Infancy,** the period between birth and the completion of the first dentition.
4. **Childhood,** the period between 2 and 7 years.
5. **Adolescence,** the period between 7 and 14 years.
6. **Puberty,** the period between 14 and 20 years.
7. **Adult age,** the period between 20 and 30 years.
8. **Maturity,** the period between 30 and 45 years.
9. **Turning-time,** the period between 45 and 60 years.
10. **Advanced life,** the period between 60 and 82 years.
11. **Old age,** the period between 82 and 100 years.

1. The Intra-uterine and Gestation Period.—The health, habits, and conduct of the mother during pregnancy modify the future individual considerably. Whatever affects the blood of the mother affects that of her fœtus, and *vice versâ*. There are grounds for thinking that the mother possesses and exercises purifying and excretory powers over the blood of her fœtus, appropriating into her own eliminating organs, and in some degree removing from her offspring, taints or disease-germs derived from the father of the child, perhaps suffering from these herself vicariously. This surmise has been offered to explain a fact not infrequently observed, that previously healthy wives, born too of healthy stocks, married to consumptive husbands, after breeding one or more children, tend to die themselves of a rapid form of phthisis, although bearing children not necessarily consumptive. On the other hand, delicate women who have been impregnated by exceptionally sound sires are observed to improve in vigour and robustness with each succeeding pregnancy. It is certain that small-pox, scarlatina, and measles may be conveyed by the mother to the child *in utero*; that typhoid fever occurring to the mother is usually fatal to her fœtus; and that the poison of syphilis derived from either parent is extremely pernicious to the growth and development of the fruit.

Alcoholic abuses committed by the mother during pregnancy favour premature delivery,

and appear beyond this distinctly prejudicial to the health of the children when these are born alive, the constitutional flaw not showing itself by apparent malnutrition so much as by undue proclivity in them to manifest disorders of the nervous system—chorea and epilepsy in childhood, hysteria and insanity in adult years. Experience shows the hygiene of this period to consist in temperate living. The pregnant woman should avoid excitements of all kinds, take moderate exercise, rise and go to bed early, not alter her habits of life abruptly. In the later months she must dress herself appropriately to her state, not so as to interfere with the emerging of the uterus from the pelvis, or so as to limit the movements of the babe *in utero*.

2. **Birth.**—Béclard in his work (*Hygiène de la Première Enfance*, Paris, 1852) pointed out a fact of some importance in the hygiene of birth. When the fœtus with its membranes and placenta are separated from the mother, and independent existence is commenced, a good deal of blood, properly the newborn child's, remains, and is for a short time after actual birth lodged in the cord and placenta. If time enough be allowed, and the newborn be kept properly warm the while, all this blood—some two ounces or thereabouts, and therefore no unimportant quantity when the weight of the child is considered—will find its way into the infant's body; whereas, if the cord be tied and divided too quickly, and before the umbilical vein becomes collapsed and empties itself, the child is mulcted of its natural blood-endowment. According to Pinard's observations, it is easy to distinguish the babies who thus receive their full complement of blood at birth from those who do not. The skin of the former is rose-coloured and plump, whereas the skin of the latter has an anæmic or icteric tint, and is poor; the former infants grow and develop more rapidly, and are altogether more vigorous than the latter. As a guide to the accoucheur's practice, he inculcates careful observation of the cord at birth. All pulsation ceases in the umbilical arteries directly the newborn breathes and cries; but for some while, different in different cases, the umbilical vein remains full; and the blood in it continues liquid up to the moment when its last drop is absorbed into the child's body. But the cord must not be ligatured until the umbilical vein is flat and empty. The accidents incidental to birth are multifarious, and belong to the subject of parturition. We may notice specially asphyxia from prolapse and compression of the cord; and prolonged pressure upon the infant's skull inducing epicranial cephalhæmatoma, and, rarely, apoplexy and paralysis.

If the temperature of the external air is about 60°, children may be allowed to go out when they are eight to fifteen days old, after cicatrisation of the umbilicus. Children born in February and September appear to possess the greatest vitality, those born in June the smallest. According to statistics carefully collected by Dr. E. Smith in his work on *Health and Disease*, p. 267, 'the viability of the infants born in the winter and spring months is greater than that of those who come into the world in summer or autumn.'

No artificial purgative, oil, gruel, or sugar-water, should be given in lieu of the mother's first colostrum milk.

3. **Infancy.**—The period of infancy might be subdivided into *early* and *late*: *early* comprehending the time from birth to eruption of the first teeth; *late*, that from the commencement to the completion of the first dentition. The leading anatomical features of this age are the large amount of blood relatively to the solids of the body, the laxity of all the tissues, the disproportionate quantity of component water, and the large relative amount of red blood-corpuscles and of iron, which appears far in excess of that existing in adults. *See* E. Smith's *Cycle of Ages*, p. 247.

The circumstance of chief physiological importance is that the greatest growth occurs in the first years of life. Quetelet in his essay, *Sur l'Homme*, shows that the mean average weight of male infants exceeds that of females; boys at birth weighing 3 kilogrammes 20 grammes, and girls 2 kilogrammes 9 grammes. There is no indicator so infallible as the balance to prove whether an infant is or is not being properly nourished. It appears that from birth up to the end of the second day all newborns lose weight a little; they do not increase perceptibly till after the end of the first week.[1]

M. Odier states that it is usual to find an infant increase 30 or 40 grammes (461 to 606 grains) *per diem* during the first five months of life, 20 grammes (308 grains) a day from the fifth to the eighth month, and 10 grammes (or 155 grains) daily between the eighth and the twelfth month.

Dentition is the change most characteristic of the infant's growth and development.

In infantile life all the vital functions go on rapidly. The pulse at birth ranges from 130 to 140 per minute; and to the end of the first year is from 115 to 120. The rate of respiration is from 25 to 30. While the circulation is rapid, the skin, from its softness and vascularity, disperses heat rapidly; the cooling agencies are at a maximum; and the heat-maintaining powers (that is, resistance to depressing influences) are at a minimum. 'The food taken by infants is, in proportion to the weight of the body, from three to six times greater than that taken by adults' (Dr. Smith, *op. cit.*, p. 247).

The perils from without to infant life are

[1] The infant should be weighed naked in a warm room, lying on a piece of flannel of ascertained weight, in the scale of a balance sensitive to a drachm.

mainly derived from cold, those from within result chiefly from improper or defective feeding, and from the over-sensitiveness of the nerve-centres. Young brains and spinal cords are over-alert to impressions received from without, and act too impulsively upon them. Control powers become developed as they grow older. The ordinary phrase 'emotional as a young child' expresses a physiological fact. It is not easy to over-feed young infants. If proper food, that is, their own mother's milk, be given them, they get rid of excess quickly enough by vomiting it, and the part not appropriated in growth or maintenance is stored up for future use as fat. The morbid tendencies of this period are towards the intestinal and mucous tracts. Catarrhal diarrhœa and bronchitis, thrush and stomatitis, are epiphenomena of all febriculas and states of malnutrition. Delirium and convulsions attend all general disorders. Over-rapid dentition is associated often with tubercularisation, retarded dentition with rickets. The more rapid the eruption of the teeth, the greater the attendant disturbance; the more closely the evolution of the teeth follows its normal periods (*see* TEETHING), the less conscious are infant and mother of their appearance. The hygienic rules for this period have reference principally to feeding, cleanliness, clothing, open-air exercise, and the avoidance of cerebral excitement.

DIET.—For diet the reader is referred to the article DIET, where the proper aliment for infants is fully discussed. Experience proves that nature will not be contradicted—that no aliment is so appropriate as the milk of a mother, or of a wet nurse aged between twenty-two and thirty-five. Next best to this comes the milk of a goat; and next, again, a mixture of equal parts cow's and ass's milk given by a feeding-bottle. The suckling of her own infant by the mother for nine months is good not only for the child, but for its mother. The uterus passes through its retrograde involution more rapidly, no periodic uterine congestions delay it, and ovulation is deferred. With respect to the frequency of feeding, and the quantity taken, the reader may be referred to the statements of Proust.[1] During the first day of life, what with scantiness of the colostrum, mechanical obstacles to suction, and the weakness of the infant's efforts, the child does not extract more than a drachm each time it is placed to the breast. It needs no more, however. During the first week of life it should be nursed ten times in the twenty-four hours, arranging times so that the mother gets six hours' consecutive rest at night. On the second day each suckling should furnish about 5 drachms of milk. On the third day each suckling should furnish about $1\frac{1}{2}$ ounce of milk. On the fourth day each suckling should furnish about 2 ounces of milk. During the first month average-sized infants require and obtain nearly 3 ounces of breast-milk at each nursing, and should be nursed nine times in the twenty-four hours, or receive about 27 ounces of milk a day. During the second month each suckling should furnish $4\frac{1}{2}$ ounces of milk, and the number of feedings may be reduced to seven *per diem*, which allows $31\frac{1}{2}$ ounces each twenty-four hours. At three months old the infant sucks about 5 ounces at a meal, an equivalent of 35 ounces each twenty-four hours; and at four months it extracts as much as $6\frac{1}{4}$ ounces of milk at each meal, which may be again curtailed to six each day, giving $37\frac{1}{2}$ ounces of aliment. This continues to be the quantity of milk and frequency of feeding required of a good nurse up to the end of the ninth month; but the quality of the milk during this period steadily improves, becoming enriched according as the child sucks more vigorously and at longer intervals, a provision fraught with mutual advantage to child and mother.

At the ninth month the child may be gradually weaned, although the age for weaning should be governed by the health of the mother or nurse, the forwardness of dentition, and the infant's own craving for other food. The best time to take for the purpose is the interval or pause after the four lateral incisors are cut, and before the first molars appear.

Dentition, normal order of. — For this subject, *see* DENTITION, Disorders of.

CLEANLINESS AND CARE.—The infant requires washing all over from top of head to sole of foot night and morning every day, and is best, because most quickly, immersed in a tub once daily. Infants who have had convulsions at any period of their lives are, as a rule, better washed all over with a sponge in the lap of their nurse than immersed in a bath, as immersion is apt to frighten them. The water should be the softest procurable. Rain-water is best. The temperature of the room during the bath should be between 65° and 70° F.; that of the bath itself, fixed by the thermometer, between 70° and 90°, according to the season of the year. Fixing the temperature of the bath should not be left to the possible indiscretion of a nurse; many a woman's hand will support water at a heat enough to parboil a baby.

The nurse should be required not to dawdle over bath or dressing; the former should occupy five minutes, the latter not more than twenty. Little or no soap, or only soft soap, should be employed. The drying should be accomplished with soft dry cloths; and for baby powder, to prevent excoriations, fuller's earth cannot be surpassed. Eczema and intertrigo are obviated by due attention to the frequent change of diapers and to cleanliness.

[1] *Traité d'Hygiène* (Paris, 1877), p. 115.

Clothing.—No infant ought to be swathed like a mummy; it requires keeping warm, but should not be overweighted with clothes. Its chest must be free to expand, its limbs at liberty to move. The more lightly its head is covered, and the more quickly all caps are dispensed with, the stronger will be its hair and the less its susceptibility to catarrh. Nightcaps are dirt-traps, and in all classes alike promote scalp eruptions by provoking perspiration, with which the skin is softened, and by the decomposition of which the sebaceous follicles are irritated and clogged.

General Rules and Hygienic Advice.—Even the youngest infants require sunlight and open air. Due discretion must be employed, however, in sending them out. They are better carried in their nurse's arms, and thus assisted to maintain their own heat by that derived from their nurse's body, than placed in perambulators. As soon as they can crawl they should be encouraged to do so, either on a carpet, in a garden, or on a dry, sandy pathway protected from wind and open to sunlight. Cold and dark places are specially inimical to them; and when the weather is cold they should be encouraged to amuse themselves on a blanket or soft hearthrug, so as to learn to stretch their limbs and co-ordinate all their muscular movements. They learn first to sit up, then to stand, helped by their arms, against a chair; next to stand without support; and at some period between one year and two years of age should be able to walk about by themselves.

Sleep.—Infants require day as well as night sleep. Very young babies do little else but suck and sleep. As they grow they need and take less and less sleep, and by the time the first dentition is accomplished—three years of age—a child may usually dispense with day sleep altogether, except a short hour's nap early in the afternoon or between eleven and twelve. Sound sleep coincides in the infant, as in the adult, with short sleep hours, and the strongest children require least sleep. The infant should have its own cradle, and the child its own cot, placed close beside the bed with its mother or nurse. In extra cold weather, or hard frosts, the cot should be artificially warmed by a hot-water bottle. The sleeping nursery ought not to be kept warmer than 65°, nor colder than 50°; whilst the nearer it is maintained to 55° during the winter months, and 65° during summer, the sounder the child will sleep. The more freely the whole house and nurseries are ventilated, the less prone the infant will be to all infantile disorders.

4. Childhood.—In this period, between the second or third and seventh years of life, the first dentition is accomplished, the second uncommenced. The rate of pulse falls from 115 to 90 per minute, and respiration commensurately. The excretions are all absolutely increased. In the co-ordination of muscular movements and in mental operations great progress is being made. The cerebro-spinal structures, which nearly double in volume between birth and the second year, continue to develop disproportionately to the growth of the trunk and limbs between two and seven. The cellular tissues are loose and vascular still, and the cutaneous and mucous surfaces therefore extra vulnerable. A notable physiological feature of this age is the readiness to swell observable in the lymphatic glands upon the slightest irritation, and the general functional activity of all the lymphatic structures. It might be distinguished as the life period of greatest *lymphatic activity*. From these facts the morbid imminences may be inferred, namely, a tendency to eczema and to catarrh of mucous surfaces, diarrhœa, laryngeal and bronchial catarrh, general anasarca, hydrocephalus, susceptibility to contagious impressions, proclivity to tubercular meningitis, and to functional cerebral disorders like delirium and convulsions. The incontinence of urine, so frequent in early childhood, may be likewise referred to the reflex irritability of the spinal centres characteristic of this age. According to Lébert, the cerebellum attains its largest size relatively to the cerebrum between 4 and 5, to which circumstance has been referred the occasional sexual excitability and vicious practices discovered in some children at this early age. However this may be, the importance of good nurses and wise supervision cannot be too much insisted on, as also the inculcation of healthy habits and provision of proper amusements and employments.

Diet.—While bread, starch, and flesh foods are taking the place of cows' milk very greatly, they must not be allowed to wholly supplant it. Eight ounces of bread may be reckoned about equivalent in nitrogen content to one pint of milk, but the former exceeds the latter in carbon. The food must be nutritious and abundant. The error committed is far too often that of under- than of over-feeding. Young children do not require so much variety in their food as adults do, but are greatly benefited by a change in their bread and meal stuffs, and a dietary not too monotonous. They do not need meat more than once a day, and fish may be substituted for meat, if cream or butter sauce be provided with it, once or twice a week. Milk, bread, porridge, suet puddings and milky puddings should form the staple of their dietaries; fresh vegetables well cooked, watercress, cooked fruit, and oranges are most useful adjuncts; while the addition of fried bacon, clotted cream, and oil, or butter, when the drinking-water is hard, and the tendency of the child is rather towards constipation than otherwise, is now fairly generally understood.

It is usually easy and always beneficial to instruct young children to secure an alvine evacuation directly they rise of a morning, and before their bath. Four meals a day are most appropriate—a breakfast at eight, a dinner at twelve, a tea at four, and a supper at half-past six.

Cleanliness.—Washing all over once a day, and in the morning, is as necessary as ever; but after first tubbing in hot water between 98° and 100°, the child should stand up and be sponged all over from a basin of cold water, and be briskly dried with a large towel.

Sleep.—A child should sleep in a cot or bed by itself, but in the same room with its parent or nurse, since it is apt to show any disorder by night vagaries, delirious talking, restlessness, or sleep-walking.

Between 2 and 5 most children are the better for twelve hours of sleep out of the twenty-four. At 7 years of age they do not require day sleep, but should be in bed at seven or half-past seven, and up at six in summer and between six and seven in winter. The best bed for this age is an ordinary iron bedstead, with firm and level wool and hair mattresses; not spring beds, which do not adapt themselves so well to light bodies, nor keep them uniformly warm. Cotton sheets, blankets, and counterpane must be used according to season. Beyond saying that the day clothing should be warm, and merino or wool put next the skin, we can add nothing further about clothing.

Exercise.—Two things are requisite for healthy growth and development and a happy childhood—a play-room and a garden. Children need a place like an empty barn, in which they can swing and amuse themselves in wet and wintry, as well as in hot sultry weather, practising those games which are requisite for the schooling alike of their muscles and nerves.

Teaching.—Teaching such as they need should be conducted on the Kindergarten system; but the main rule for their lives is open air and exercise, the chief objects being to harden their skins, develop their muscles, and teach them self-control, love and respect for those to whom they render implicit, because well-nigh unconscious, obedience.

5. **Adolescence.**—The consideration of this, the period of second dentition, between the ages of 7 and 14, is best prefaced by the order of eruption of the second teeth.

About 7 years the 4 anterior molars (permanent teeth) are cut.

About 8 years the 4 central incisors.
" 9 " 4 lateral incisors.
" 10 " 4 anterior bicuspids.
" 11 " 4 posterior bicuspids.
" 12 to 12½ " 4 canines.
" 12½ to 14 " 4 posterior molars.

The teeth of the lower jaw usually precede those of the upper. Second dentition is accomplished leisurely, and is therefore usually accompanied by no such grave disorders as mark first dentition; but in nervous children nervous tricks may manifest themselves, as well as marked lack of emotional control. Some are hypersensitive, others contradictory and difficult; and most parents admit that between 7 and 8, if not between 7 and 14, they learn what the characters of their children really are. Physiologically, absorption of the subcutaneous fat goes on rapidly, while the muscles become more developed, the skin gets tougher, its epidermis harder, and it perspires less readily. In our climate the morbid liabilities of this age are to rheumatism, chorea, epilepsy, the exanthemata, and typhoid fever.

Between 7 and 8 the appetite is apt to become capricious; the child physiologically does not require so much hydrocarbonaceous food; and, while growing fast and becoming leaner, protests against fat, often while showing a marked longing for fresh fruits, in which nature should be indulged. After 8, however, any marked defect of appetite or loss of weight is suggestive of undue cerebral excitement, attributable to over-study or some infraction of the laws of health.

Diet.—Three good meals a day are sufficient, but four are more advisable. Constipation at this age usually signifies irregular feeding and overloading with pastrycook supplies or other improper food. Breakfast at eight, dinner at one, tea at five, and supper at eight appears the best distribution. By supper is meant such a meal as growing lads and girls positively need. They require either soup and potatoes, and bread and butter, or some one hot dish of meat or fish; and the drink should be either warm milk or cocoa to about half a pint of fluid: aliment enough is needed to improve the circulation at the extremities and obviate chilblains. Boys and girls may retire to bed within an hour of their supper, which, instead of making them dream, will secure good and refreshing sleep. The greatest dangers at this age arise certainly from defective nutrition and an over-sensitiveness of the skin. Neither wine nor beer is necessary, nor should either be allowed without medical authorisation.

Clothing.—The objects of clothing are warmth, cleanliness, and convenience. Vests of cotton and wool, merino, or spun silk should lie next the skin of the chest and trunk. Merino, flannel, or other woollen materials should protect the legs and feet; cloth, woollen jerseys, furs, and skins are adapted for external coverings. But a whole chapter could be devoted to the foot alone, and its clothing during its growth and development. The desiderata appear to be length and breadth enough, low heels, impervious soles, old and flexible skins for uppers. Boots for outdoor exercise are advised for children, because their ankles need support; shoes a little later

on, because they are cheaper and do not repay re-soling, and may be discarded at once when worn out. The same boots should not be worn day after day—they require time to dry properly in damp weather, and the foot at that age profits by change of pressure. During youth the adaptation of clothes to special sports and exercises is far from unimportant to health. For violent muscular exercise, flannel or merino should be worn next the skin, and an easy flannel jacket or over-jersey; both after being used should be hung up to dry and air before being worn again. It is well that youth should be informed how rheumatism is promoted by indolence, neglect of exercise, carelessness in getting overheated, standing about on damp soils, remaining in wet shoes, wearing woollen shirts or under-clothing that have been permeated and saturated over and over again with the secretions of the skin.

Rest and Exercise.—These are requisite for both body and mind at this age; the duty belongs to parents and schoolmasters to study what is appropriate. We annex, therefore, a table from Friedländer, which shows how the twenty-four hours may be wisely apportioned:—

Age	Hours for			
	Exercise	Work	Leisure	Sleep
7	8	2	4	9 or 10
8	8	2	4	9 or 10
9	8	3	4	9
10	8	4	4	8
11	7	5	4	8
12	6	6	4	8
13	5	7	4	8
14	5	8	4	7
15	4	9	4	7

6. **Puberty.**—The physiological feature of this period is the more rapid growth of the whole body, and the gradual perfectioning in their functions of its several organs. Between 14 and 20 the human plant reaches not only its full size but the completion of its organic endowments. During this period mind and body expand together, but the body develops more rapidly than the mind. Growth in man, as in plants, proceeds by fits and starts, succeeded by periods of quiescence; seasons affect it, so do supplies of food; boys do not develop so rapidly in autumn and winter as in spring and summer. Girls at this age often fall back, as it were, a little in winter, when they are much more confined indoors, to make a greater push forwards in spring.

It is even difficult for the digestive and assimilative powers to keep pace with the bodily requirements, so that the tendency is for the temperature of the body to fall somewhat, to be ill maintained at the extremities, and for the cold bath to be shunned for lack of adequate reaction in those who are manifestly growing very rapidly.

The heart in some is hardly equal to the task set it, and when it is diseased we perceive both growth and the attainment of puberty retarded. The lungs, again, as Dr. E. Smith pointed out (*op. cit.*, p. 288), more often in girls than in boys, do not expand in proportionate ratio with the rest of the body. The body runs up tall, but the thorax remains narrow and flat, and the apices of the lungs approach too closely to each other. The definition of a line—length without breadth—is too closely imitated. The morbid imminences of this age are disorders of the nervous system, chorea, epilepsy, mania, anæmia, rheumatism, pneumonia. Girls during this period of their lives suffer more illness than boys, probably in consequence of insufficient gymnastic exercises, over-study in cramped postures, and from that folly of follies, a forcing-pit education, 'all articles warranted to be turned out highly finished by eighteen years.' It is the age of all others when good or bad habits of life are formed; the time, too, when the seeds of disease are sown broadcast, to spring up in the after-age of man- and womanhood.

Diet.—Food should be abundant, varied, but unstimulating. Three or four moderate meals a day are requisite; if at any period of life fermented liquors are beneficial, now is that time. Light bitter unadulterated table-beer or claret and water should be provided at dinner, but not more than half or three-quarters of a pint of it allowed. If violent exercise has provoked thirst, this may be satisfied with plain water or toast-and-water *ad libitum*. Girls should take cocoa-nibs for breakfast, with bread and butter, meat, eggs, bacon, or fish, as much as they like. School dietaries err usually on the side of deficiency. At dinner, as well as substantial meats, fruits, vegetables, and suet- and milky puddings are required. Tea should be allowed only once in the twenty-four hours, at six o'clock, and a warm supper be provided at nine o'clock.

Clothing.—Nothing need be added to what has been already advised. Without entering into minute particulars, it should be seasonable, rather extra warm, and offer no uncomfortable restraints. When mothers complain of their daughters' neglected figures, the hygienist retorts, What gymnastic exercises did you require of them? It is the age for exercise of the body as well as of the mind. Boys' spines are straight and girls' backs crooked because the former use all their muscles and the latter do not. As the body is making its most rapid growth, so the evil of unilateral use of muscles is particularly baneful. Sitting over-long in a slouching attitude will tend to contract the chest, as carrying too heavy weights over the back will spoil the normal spinal curves; so leaning

too much on one side, standing too long on one foot, even carrying constantly a pocketful of articles on one side of the dress, will suffice at this age to induce spinal curvature. The daily use of the trapeze, swinging, playing games like *la grâce*, in which both arms are used, badminton, and lawn-tennis, in which arms and legs are employed, and every muscle brought into due action, are quite essential to the proper development of the thorax and the muscles of the trunk. Girls should row and run and ride and swim and skate no less than lads do, in order to become fit mothers for a nation like ours.

The best temperature for a sitting-room is 60°; that for a sleeping-room between 50° and 55°. The hygiene of the bedroom and the bed needs a few words. The temperature of the room should not rise above 65° in summer, or fall below 45° in winter. It must be thoroughly ventilated with a constant amount of fresh air passing through it during the day. The desiderata for a bed are coolness for the spine, restfulness for the trunk muscles, and warmth without too great heat or too burdensome a weight of bedclothes: all objects are well attained by a French *sommier élastique*. A horse-hair bolster is preferable to a pillow, and a paper pillow to a feather pillow; a feather pillow enwrapping the neck and head heats the upper part of the spinal cord undesirably. Posture in bed is not unimportant. The head should be low, the feet perhaps a trifle raised, certainly not dependent. 'Sleep not on your back, as a dead man,' is a maxim attributed to Confucius; the opposite attitude, on the stomach, is restrictive of the intestinal movements, and uncomfortable. It is as well to begin the night lying upon the right side so long as food remains in the stomach, and to turn on first waking upon the left side. The best attitude is probably that crouched one habitually selected. Good advice is to stretch yourself straight whenever you wake, in order to render the circulation of the blood freer. In winter the arms should lie under the clothes, in summer above them.

The cold bath, or cold sponge, or shower bath should be taken by the robust every morning; with a warm or tepid bath once a week, for cleansing purposes, throughout summer and winter. Whilst the young of both sexes should be encouraged to swim, in seasonable weather, the length of time they stay in the water must be strictly limited according to the temperature.

We abstain purposely from any discussion of the hygiene of *mental* education.

7. **Adult Age.**—This is the prime of life, between 20 and 30. Anatomically, the body broadens, the chest deepens; for feats of muscular prowess—short, severe labours—it is at its best. The intellectual and cerebro-spinal sexual energies are at their maximum. What the French call the greatest latitude of health, and of strength, exists at this period; severe strains are supported with apparent ease. In male adults the body gains weight by small amounts for about twenty-eight days, then relapses to its normal average by a sudden crisis, attended by head-heaviness, loss of appetite, and copious discharge of urine, or seminal evacuation. It is not a time about which the hygienist has much to say. If the preceding periods of life have been wisely ruled, the individual is at his or her best. The morbid imminences directly belonging to this age should be few, and certainly are usually due to direct contravention of the laws of health: to exposure to contagious influences, to irregular living, especially drinking, to excessive strains upon the heart or its blood-vessels, to pulmonary inflammations, to contravention of proper sexual relations, to over-emotional excitement, or to mental worry and loss of sleep.

The guiding rule for this period is succinct enough: '*Sustine et abstine.*'

Qui studet optatam cursu contingere metam,
Multa tulit fecitque puer, sudavit et alsit;
Abstinuit Venere et vino.

Hitherto excess in feeding was difficult to effect, quickly punished, and admitted of rapid and spontaneous repair; but now he who would rise above the ruck must rule with a tight rein all his appetites. The penalties are not exacted directly after the offence is committed: they are kept in store, but nature inflicts them with pitiless justice.

Total abstinence from alcoholic drinks may be recommended. Not only does it favour health, but lessens all the temptations incident to these important years, in which a man carves out his own career. A question not infrequently propounded is, How shall I know when I have eaten more than is good for me? If individuals are dull or drowsy after a meal they have usually eaten too much; if they can converse, write, or transact business with ease after a meal, they have fed temperately.

Women may be advised to marry not earlier than 21—between 21 and 28—when in our climate they are best fitted to become wives and mothers. Men had better wait till between 28 and 35 before they undertake the responsibilities of being parents. For the generality of men and women we must insist once more on their not giving up out-of-door muscular exercises. An entirely sedentary trade or office-life cannot be a healthy one for either body or mind: the latter appears to suffer most from it—the sense of morality becoming blunted. When the struggle for existence is so severe that, with early rising and very limited hours of sleep, no leisure hour remains for sports or amusement, the time has arrived for emi-

gration, war, enforced military service, or revolution.

Sleep.—Doubtless different constitutions and individuals differently employed require different amounts of sleep. As nothing dulls the intellect and weakens the recuperative faculties more than too much sleep, except over-feeding and drinking at this age, so few things are more certain than that a man may rise too early for making the best use of his twenty-four hours. He must live in the world and keep the world's pace still. John Wesley's advice in this matter is worth recording. He writes that any man can find out how much sleep he really requires to repair his nervous system by rising half an hour earlier every morning until he finds that he no longer lies awake at all on going to rest in bed, or wakes up until it is time for him to get up. Six to eight hours is usually ample for healthy adults, with nine hours every seventh day. The mistake too often made is that of endeavouring to make up for over-hard mental efforts by over-long sleep hours. Mental over-fatigue is to be repaired not by sleep, but by bodily exercise in the open air. Exercise directs the blood-flow from the head towards the muscles, and renews the appetite. As we have pointed this out as the suitable age for marriage, we may mention some things which conduce not slightly to healthful and happy marriages: parity of station, similarity of temper and tastes, and no disproportion either in age or size.

8. **Maturity.**—The body has now reached its maximum weight and solidarity, and the period is that of maximum endurance. Men reach their full weight at 40; women later, sometimes not till 50. At this age the soldier is fittest for service, the labourer for work, the artisan and professional man for their respective duties. 'High to soar and deep to dive is given to man at thirty-five.' The morbid tendency is towards anæmia and obesity, the former promoting the latter, and both alike being determined by a too sedentary town-life, and by daily occupation in close, ill-ventilated, and badly lighted chambers. Now are perceived the first attacks of gout; whilst visceral degenerations and atheroma of arteries may manifest themselves — events all of which may be delayed, if not wholly prevented, by attention to the laws of health. It is desirable that each individual should pay heed to his weight at this age, since this indicates whether or no he is living wisely. Celsus (lib. 2, cap. 1) writes: 'Corpus autem habilissimum quadratum est neque gracile neque obesum. Nam longa statura ut in juventa decora est, sic matura senectute conficitur. Gracile corpus infirmum, obesum hebes est.' When, however, men are engaged in trades or professions, there is no more difficult task than to maintain their weight at this age, the *juste milieu* referred to being a hard matter to secure. The advice given by Celsus (lib. 1, cap. 1) cannot be surpassed in force or brevity: 'Sanus homo qui et bene valet et suæ spontis est nullis obligare se legibus debet; hunc oportet varium habere vitæ genus, modo ruri esse, modo in urbe, sæpiusque in agro, navigare, venari, quiescere interdum; siquidem ignavia corpus hebetat, labor firmat.' As to diet, clothing, and habits, we need add nothing to what has been already advised for a previous age; but on exercise of body and mind there is much to be written.

A good rule is laid down by Lynch, too, in his *Guide to Health* (p. 290), that the lean should exercise *ad ruborem, i.e.* to glow-point, or until their bodies and spirits are heated, for that will fatten them; and the fat *ad sudorem.* The more luxuriously a man lives, the more exercise, and the more active exercise, he needs. Want of it, and the costive habit thus superinduced, may, as Kotzebec observes, extinguish the divine flame of genius and seriously impair the intellectual powers. Hypochondriasis and hysteria are the special punishments of ease and affluence and indolence. Obviously a portion of each day should be set apart for exercise for those who can take it. In the households of the wealthy a gymnasium is at least as important as a bath-room; and twenty minutes every morning before breakfast might well be devoted to breathing the muscles—that is, calling into play every muscle of the trunk and limbs. The chest should be expanded by clubs and dumb-bells; swinging on the trapeze, and hanging by the arms and legs, may be recommended. Again, before forenoon or midday meal, an hour's ride or walk must be obtained; and a third time in the day an hour and a half's exercise —fencing, or walking, or rowing—should be arranged before bedtime, in the spring and summer seasons. A great point is to vary the exercise by every means at hand: to change the set of muscles called chiefly into play upon different days, as Celsus advised: to swim, ride, fence, sail, row, shoot, fish. Lastly, we can recommend those only who are very robust to take a long walk before breakfast. Bodily exercise should not be undertaken immediately after a heavy meal; nor should those who have sweated themselves violently sit down at once to a full meal—at least an hour's rest should intervene.

Let us pass on from the exercise of the muscles to that of the brain, since here, too, the hygienist may be expected to give a few words of advice as to what is proper and profitable in mental work, and what is improper and likely to prove detrimental to the cerebral organs. Our own experience entirely confirms that of others, that most brains suffer more from rest than over-work. Exercise is

as essential for the healthy nutrition of the cerebral as it is for that of the muscular tissue; and without regular employment daily up to fatigue-point no high quality of intellectual condition is ever attained. Fret, hurry, worry, and the endeavour to accomplish some task in too short a time, is what wearies and wears the thinking organ; but what damages it is always its imperfect nutrition, the insufficient repair of its waste after its active employment. It is a matter of observation that feeble brains, those constructively defective, or those damaged by accidental injury or by disease, most speedily suffer both from over-work and from actual disease: the education of the half-witted, and of the congenital idiots is a difficult problem as well as a disheartening task; that they admit of some improvement is proven, but directly their daily exercises are discontinued they fall back. Immature brains are doubtless more vulnerable and require more rest, more sleep, and more diversion than fully developed ones. Again, the mere degenerative changes in the blood-vessels and capillaries incident to disease and old age interfere with the nutritive changes requisite for the most perfect intellectual operations. Hence it is easy to point out a true pathological foundation for epileptic insanity and senile dementia, and to perceive why poorly fed children should suffer from over-pressure in schooling.

The cultivation, however, of the human mind, and the determination of what is best for its sound development and maintenance, belong to education, not hygiene. Let it suffice to say that the *mens sana in corpore sano* depends as much upon the judicious training and education of the intellectual centres, as it does upon their minute structures and sound nutrition. The best intellects are built on good foundations; the education of the cerebral centres begins with the first special sense impressions made upon them, and, we may hope, does not terminate only with this life. There is still as much to be learned in the training of the brains as there is in that of the muscles. True excellence is only to be reached after much striving, and can be attained only by gradual steps, and slowly.

9. **The Turning Period.**—This period of life, which lies between 45 and 60, is also known as *the grand climacteric*, or *middle age*. The skin wrinkles. Up to 60 years of age the skull may continue to increase in size, principally at its anterior part, by enlargement at the frontal sinus; after 60 the skull-cap loses weight, and the brain may waste, but gets tougher and firmer. The heart grows a little larger, and its walls are thicker. The lungs grow denser, a change common to every tissue of the body. The hair grows grey; the features sharpen; the sight alters; and the hearing grows dull. Pressure and wear and tear begin to tell at every part. Upon the blood-vessels their effects are more marked in males than in females, because ordinarily the former labour harder than the latter; further, the death-rate of men is greater than that of women at this age. As the sexual powers decline, which they do by a quick descent between 46 and 63, the intellectual powers increase, so that mentally there is often exhibited a marked increase of vivacity and agreeableness, more noticeable in men than in women. In the latter the cessation of the catamenia is attended usually by some rejuvenescence, attributable to their recovering a little embonpoint. It is an age, however, at which women kick rather, and become restless and uneasy, the change of life being attended in many by a renewal of their juvenile tempers, as between 7 and 14, and occasionally by a revival of their youthful ailments, such as eczema, skin eruptions, and various neuroses, insomnia, hysteria, and sometimes epilepsy. In character, whatever obstinacy exists reaches its climax.

Morbid Imminences.—The inflammatory disposition is lessened, but there is a tendency to venous plethora of the abdominal viscera, and towards vicarious hæmorrhages. Gout assails its victims with well-characterised attacks. New-growths, simple and malignant, tend to demonstrate themselves, and rheumatoid arthritis to appear. Dr. Waterhouse, in a letter to Sir T. Sinclair, published in his *Code of Health and Longevity* (vol. i. p. 33: Edinburgh, 1807), notices the three following periods as very important in every human life, as sickly or moulting times. The first he had noticed to befall males chiefly at 36 years of age, when the lean person becomes fatter and the fat kine leaner. The second sickly period happens at some time between 43 and 50, and lasts a year, or perhaps two. During it the complexion fades, the appetite fails, the tongue becomes furred at the smallest over-exertion of body or mind, the muscles are flabby, the joints are weak, sleep is unrefreshing, and the spirits droop. It is no particular organ that suffers, but a uniform deterioration that is manifested. At this time a man first experiences a reluctance to stoop, prefers a carriage to riding on horse-back, and perceives each change of the weather affect him. This observation of Dr. Waterhouse has, according to the experience of many, much justice in it; as also that between 61 and 62 a similar deterioration of health takes place, but with aggravated symptoms.

Hygienic Rules.—At the menopause women should be advised to abstain, as a rule, from alcoholic drinks, and to avoid highly spiced and seasoned dishes. They may be recommended to take meat not more than once daily, and to live chiefly on farinaceous food,

milk, eggs, vegetables, and fresh fruits. A tablespoonful of lime-juice taken twice daily occasionally for a week or ten days at a time has a salutary, depurating effect upon both stomach and kidneys, and clears the tongue when this is foul in the morning. Riding and walking exercise are highly appropriate, but very violent muscular efforts should be avoided. If the individual be thin, and growing thinner, the clothing should be extra warm. Flannel abdominal belts may be worn advantageously in all seasons, but especially in autumn and winter.

Both sexes should avoid emotional excitement, and the stimulation of waning sexual abilities. Prolonged exposure to wet and cold is sure to be seriously resented. Hot or Turkish baths, succeeded as they should be by the cold plunge or douches to remove the lassitude otherwise provoked, are very beneficial, and taken once a week may be safely indulged in throughout the year. It becomes extra important as the subcutaneous fat gets absorbed, and the skin wrinkles, to keep its pores clean and open and capable of perspiring.

10 and 11. **Advanced Life, and Old Age.**—The period of advanced life—60 to 82, and old age, from 82 upwards, may be advantageously considered together. When a man turns his toes out much in walking and treads upon the whole base of his foot, when he is always stopping and turning round to look back, he is already old. The sagacious 'boots' at an inn can tell a man's age by the state of his shoe-leather.

'*Senectus ipsa morbus insanabilis.*' Some degenerate earlier than others, but the decline of life is characterised in all human kind alike by an indurating condition of every tissue, diametrically opposed to the cellular softness and laxity of infancy. The capillaries thicken, the arteries harden, the nutritive metamorphoses proceed more slowly. The muscles waste; the subcutaneous fat lessens; the blood becomes poorer and paler; the skin dry, sallow, and wrinkled; further, it gets less vascular, and the mucous surfaces become relatively more so. The teeth loosen and fall out; the gums recede from them; and the digestive juices fail. The arteries become atheromatous and calcareous, lose their elasticity, and are liable to fibrinous thromboses, or to embolic pluggings; and while they tend to block up at one part, their coats may split and yield to pressure, bulge out, and form aneurysms or dilatations in other directions. Hence happen apoplexies, brain-softenings, and senile gangrenes. The heart up to an uncertain period grows progressively larger and more muscular, to meet the obstacles offered to the circulation; but finally it, too, degenerates, and its walls grow thinner and dilate. The air-cells of the lungs lose their elasticity, and progressively enlarge; then merge into each other; and become emphysematous at the edges of the lobes where least supported. Emphysema implies degeneration of capillaries and diminution of aërating surfaces; and as the pulmonary area becomes thus lessened, the right heart becomes hypertrophied and dilated.

The dryness and lessened secretion of the skin cast harder work upon the kidneys in eliminating water, and increase the disposition to catarrhal fluxes from the nasal passages, the bronchi, and the intestines. Thus, while there is a constant predisposition to skin-irritation from its dryness, and to eczema from scratching and rubbing it, the other morbid imminences towards bronchial catarrh and diarrhœa very closely follow the direction given them by the season of the year, and greater or less degree of external cold. The bladder grows thicker with age, and its capacity is less; the prostate gland enlarges. Few persons after 60 pass seven hours in bed without requiring to micturate. Dr. Rush regarded the prompting to more frequent micturition as the first symptom indicative of a man's years impairing his bodily functions. The pulse feels firmer and fuller; fills quickly after food is taken, but falls in frequency and flags in power in a marked degree after fasting. It is a far less trustworthy indicator of the gravity of any febrile disorder, or of degrees of asthenia, than it was in youth or middle age; and it fails to point to the practitioner the nearness of death, unless he have large experience of it.

There is a default of reaction manifest in advanced life, so that all acute disease is clinically less easy of recognition, and the beginning of the end is therefore apt to pass unobserved. The thermometer warns the doctor of changes which old people do not notice themselves, but which it may be of considerable importance to notice. A slight elevation of temperature means much in old age, and should be heeded accordingly. The slightest change excites a young child; nothing seems to move the old man. In extreme old age life is little more than vegetative existence; the individual eats and sleeps and dreams. The sleep the aged get by night seldom rests or satisfies them. Memory is one of the first mental faculties to become impaired, but finally every sense and every faculty fail. Up to 75 the strong of both sexes usually retain their digestive powers, and a fair amount of mental and muscular vigour. Later on, indecision, inconsequential reasoning, self-distrust, uncertainty as to facts, delusions of sight and hearing, restlessness, day-dreams, night-wandering, too often prove that the old are no longer what they once were in intellect, and testify to the brain degenerations belonging to senile dementia.

Hygienic Rules.—A prime necessity for old age is warmth: nothing kills the aged so certainly as cold. It is of first hygienic importance after 75 that the individual should

be loved and cared for; old people do not, perhaps cannot, take care of themselves.

Those who live longest, and enjoy the fullest measure of activity, are those who do not over-tax their stomachs when their teeth begin to fail them, and who adapt their aliment to their enfeebled powers of mastication, by having their food properly cooked. Stews, minces, meats boiled and afterwards baked—cooked, that is, twice—are more easily digested than fresh roasts or close-fibred meats. A moderate amount of wine cheers and comforts old people; a glass or two of good Burgundy or of champagne, and an occasional glass of old port wine, or such stimulant as suits them, are most beneficial to the aged, and are better for them than overloading their stomachs with milk and farinaceous foods.

Great attention should be paid to the functions of the bowels and of the skin. Galen pointed out that old people should not suffer their bowels to remain costive beyond two days; on the third they should take some gentle purge, such as by experience they have found adequate. A hot bath once a week, and a hot foot-bath every night, may be advised. A short nap after breakfast and before dinner is the natural habit of the aged. Further, their clothing should be extra warm, and their chambers night and day be heated. They should be encouraged to go out in the open air only in seasonable weather; and, when they are equal to it, should take a little walk on a dry gravel path in some warm locality, sheltered from north-easterly winds. All change and cheerful society are good for them. If their purses admit of it, they should follow the swallows to warm winter quarters. If they must winter in England, let them shut themselves up throughout the season in a well-warmed house.

Summary.—Advice for every age may be thus briefly given: for infancy and childhood—*sustine*; for adult years—*sustine et abstine*; for old age—*sustine* again. There is less need now to enjoin *abstine*.

The hygienist, however, seeks not to lengthen out the days of age and decrepitude; his art is not to prolong life beyond its natural term, though this may come subordinately, but to render its period of activity and utility longer—'*Hic labor, hoc opus est.*' Some cynic observes that we have pointed out very few habits as worth cultivating, the truth being we believe what we have insisted on—that most bodily habits need resisting. Individual health is attained by self-denial; habits imply self-indulgence.

Reginald Southey.

PERSPIRATION, Disorders of.—See Sudoriparous Glands, Diseases of.

PERTUSSIS (*per*, signifying excess; and *tussis*, cough).—A synonym for whooping cough. See Whooping Cough.

PESTIS (Lat.).—A synonym for plague. See Plague.

PETECHIÆ (*petigo*, an attack, eruption; Ital. *Petecchie*, fleabites).—Synon.: *Peticulæ*; Fr. *Pétêchies*; Ger. *Petechien.*

Description.—Petechiæ are small crimson and purple spots of the skin, resembling those that result from the bite of a flea. They are circular in figure; are developed around the apertures of the follicles; have an average size of one or two lines in diameter; and are consequent on the transudation of the colouring matters of the blood, through the capillary vessels of the follicles, into the immediately adjacent tissues. They are distinguished from spots resulting from simple hyperæmia by pressure with the finger. Under pressure the hyperæmic spots disappear, but the petechiæ remain permanent. They are differentiated from flea-bites by the presence in these of the puncture, which is always perceptible and contrasts strongly with the lighter colour of the rest of the disc; although it is to be remembered that the colour of the petechial spot is always deepest in the centre, and becomes lighter towards the circumference. Petechiæ vary in tint of colour according to age and the amount of effused blood, being at first brightly crimson, then purple, next almost black, and subsequently fading away through the ordinary colours of a bruise. Hence it is usual to find them scattered over the skin of various shades of colour, ranging through all the tints already mentioned.

Petechiæ are met with on the mucous membranes, as well as on the skin, in purpura, scorbutus, malignant fevers, and in several forms of congestion of the follicles of the skin associated with constitutional diseases. Petechiæ do not call for special treatment. See Purpura.

The term *petechial* is applied to certain varieties of diseases, such as typhus, when petechiæ occur in their course, or the eruption becomes hæmorrhagic. See Extravasation; and Typhus Fever.

Erasmus Wilson.

PETIT MAL (Fr.).—A term applied to attacks of epilepsy which are of short duration and slight intensity. See Epilepsy.

PFAEFFERS, in Switzerland.—Simple thermal waters. See Mineral Waters.

PHAGEDÆNA (φάγω, I eat away).—A form of ulceration, which rapidly destroys the surrounding parts. See Bubo; Gangrene; Ulcer and Ulceration; and Venereal Sore.

PHAGOCYTOSIS (φάγω, I eat; and κύτος, a corpuscle).

Definition.—A term expressing the property possessed by certain animal cells, called 'phagocytes,' of taking into their substance

solid particles, which may either be rejected, be used by the cell for its nutrition, or, when the solid mass is living, may destroy the cell.

Phagocytosis, from this wide definition, is thus a process not limited to diseased conditions of the animal body, but is a part of a general property possessed by cells in animals of every grade, invertebrates and vertebrates. The cells which act as phagocytes are not highly differentiated: they are not, like the muscle-fibre or the nerve-cell, organised to perform special functions, but they possess the characteristics inherent in undifferentiated protoplasm. Two of the chief properties of these cells are the amœboid movement or power of contractility of the protoplasm, and the power of digestion. They are, moreover, very sensitive to stimuli, both chemical and physical, which diminish or increase their movements, or which attract them to one spot. To a certain extent they show a selective power, that is, they refuse to take in some solid particles; but how far this power is generalised in the different cells which act as phagocytes it is at present impossible to say. The relation of phagocytosis to disease is in part discussed in the article on IMMUNITY. The anatomical facts which have been discovered by a study of phagocytosis will alone be discussed in the present article. For convenience, it is best to consider the subject under two headings—(1) *physiological*, and (2) *pathological phagocytosis.*

1. *Physiological Phagocytosis.*—Examples of this occur in both the most lowly and the highest animals. The amœba takes into its substance solid particles which, if suitable for the nutrition of the organism, undergo digestion, and, if unsuitable, are ejected after remaining in the substance of the protoplasm for some time. The ciliated animalculæ (of which Paramœcium may be quoted as a type) also take into their substance particles of the nature just mentioned, which undergo a similar process. This intracellular digestion is also a feature in Hydra, sponges, and other allied animals. In the higher animals there are many examples of this phagocytosis, for example, in the absorption of fat in the small intestines, in which the globules are taken up by the epithelial cells and then by the leucocytes, by which they are conveyed to the lymph-stream; in the absorption of bone during ossification, and in old age by the osteoclasts; and in the absorption of the branchiæ and tail of the tadpole during its transformation into a terrestrial animal. These processes are performed by cells, playing the part of scavengers. It is sufficient to mention these facts to bring them into line with what more nearly concerns disease, namely, pathological phagocytosis.

2. *Pathological Phagocytosis.*—This is observed when a living organism is injured mechanically or infested by a parasite, or when an inert foreign body is introduced into its substance. It is a battle between the host and the parasite, in which in some cases the host, in some the parasite, gains the upper hand. Parasitism may not inconveniently be divided into two varieties: in the one, the parasite, by the bulk of its growth, may be fatal to the host by interfering with the essential functions of the organism, or of a vital organ; in the other, the parasite acts on its host not so much by the bulk of its growth as by the poisonous products which it excretes or forms from the tissues of its host. Infective disorders in man and the higher animals, so far as we know them, belong chiefly to the second variety of parasitism; to the first variety belong some of the cases of parasitism in the lower animals; perhaps also in man (*e.g.* actinomycosis). Whatever truth there may be in this division of parasitism, it must be borne in mind that it is not yet clear that every noxious parasite is capable of secreting products which are poisonous to the host. To illustrate this question of parasitism in the animal kingdom and its relation to phagocytosis, the description given by E. Metchnikoff in his *Leçons sur la Pathologie comparée de l'Inflammation* (1892) will be adhered to.

Commencing with the lowest in the animal grade, the *unicellular organisms*, such as the amœba, it has been mentioned that the solid living particles (diatoms, bacteria, &c.) ingested by them may serve as food; but some of the living bodies absorbed, instead of being digested, may actually produce a fatal disease. Thus, as Metchnikoff has shown, the amœba may take into its substance a microsphæra (an organism composed of nucleated round-cells, multiplying by division) which multiplies to such an extent as to kill the amœba. This is an example of fatal infection of a unicellular organism by a parasite. Examples of similar parasitism in other lowly plants and animals are well-established. In some instances the living bodies, diatoms and bacteria, are ingested and digested by the organism, in other instances the ingested living body multiplies and destroys its host.

The study of phagocytosis becomes more complicated in *multicellular organisms.* Of the three layers of cells of which the majority of these organisms are composed, namely, the ectoderm, endoderm, and mesoderm, it is the last to which the property of phagocytosis is eventually limited in the process of evolution. This limitation of the phagocytosis to the mesodermic cells is attained only gradually. The sponges, animals composed chiefly of ectoderm and endoderm, with a well-developed mesoderm, protect themselves against harmful bodies by means of their contractile ectodermic cells, but also by the phagocytic power of the mesodermic and endodermic cells. In them the mesodermic cells play a large *rôle* in the normal

digestion of the organism. Some of the Cœlenterata possess no mesoderm, and in these, Hydra, for example, the endodermic cells, which have the property of sending out amœboid processes and of performing the normal digestion of the organism, play the *rôle* of phagocytes; in other similar animals, the ectoderm cells are also phagocytes. Such animals are without any vascular system. This is also absent in the Medusæ, which, however, possess a mesoderm differing from that of the sponges in the fact that the mesodermic cells play no part in the normal digestion of the animal. These mesodermic cells are, however, the phagocytes. They surround and attack harmful substances introduced into the substance of the animal, and may unite together, forming *plasmodes*, an example of the formation of giant-cells low down in the animal scale. In all animals higher than the medusæ, namely, echinoderms, worms, vertebrates, &c., this formation of plasmodes, or giant-cells, by the union of mesodermic cells is very common, the plasmode in some instances completely surrounding the foreign body or parasite, as in fig. 117.

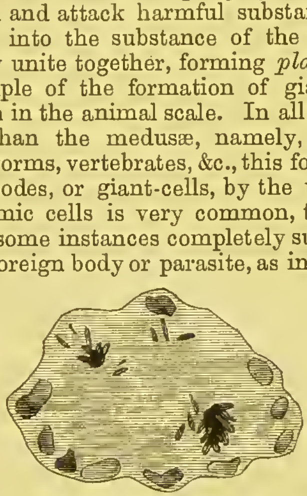


Fig. 117.—A Giant-cell enclosing the clubs of the fungus in Actinomycosis. (Verick, Oc. $1 \times \frac{1}{12} = 700$ diam.) From a preparation and drawing by Dr. Armand Ruffer.

The classes of Mollusca and Arthropoda possess a vascular system, filled with a liquid containing colourless cells. These cells are mononuclear; their protoplasm is in one variety granular, in another hyaline. They act as the phagocytes of the animal. Numerous experiments have shown that, after a lesion of a part of the animal, these cells accumulate near the injured spot as they do in an 'inflamed' area in warm-blooded animals. A similar accumulation occurs around inert foreign bodies introduced into the animal; and the cells also take up pigment-granules injected into the tissues (Haeckel, 1862). The best example of infection in such animals has been brought forward by Metchnikoff as occurring in the water-flea, *Daphnia magna*, which in a pond was found infested with a kind of yeast-fungus, *Monospora bicuspidata*. At certain periods an epidemic of this disease will kill off nearly all the daphne in the pond. A study of the process shows that the ripe spores of the fungus are eaten by the daphne, and pass through the intestinal wall into the body cavity. Here the elongated spores become surrounded by the leucocytes, and one of two events may happen. The spores may rapidly increase in number and fill the body cavity, eventually destroying the life of the daphnia; or, becoming surrounded by leucocytes, they undergo degeneration, so that they are killed or are not fatal to the daphnia.

Fig. 118.—A phagocyte of the Daphnia containing two undegenerated spores of the Monospora. (Metchnikoff, Virchow's *Archiv*, vol. xcvi.)

Fig. 119.—A spore of the Monospora enclosed by phagocytes, and undergoing degeneration. (Metchnikoff, *ibid.*)

In both cases there is a struggle between the leucocytes and the germinating fungus: in the first, the fungus overcomes the resistance of the leucocytes; in the second, the leucocytes surround and finally digest the spores of the fungus.

In the very young tadpoles of the lower amphibia (urodeles) phenomena similar to those occurring in mollusca have been observed by Metchnikoff and others. Thus, after a slight injury to the non-vascular fin of the tadpole, the amœboid cells collect at the injured spot, the fixed cells of the tissue taking no part in the process. In older tadpoles, when the blood-vessels are developed in the fin, there is still this accumulation of amœboid cells at the injured spot; but there are also the phenomena of inflammation such as are observed in the higher animals, namely, acceleration of the blood-stream, &c. As Metchnikoff points out, both the phenomena in the very young and those in the older tadpole must be classed as 'inflammatory,' although in one case there is no vascular change. Similarly, the phenomena following an injury or an infection which have been described as occurring in invertebrate animals possessing a mesoderm must be classed as inflammatory; not as belonging to a completely developed process of inflammation, but as forming one of the stages in the evolution of the inflammatory process in the animal kingdom.

Phagocytosis in the *higher animals* is a part of inflammatory and of infective processes. It is a question whether all primary inflammatory processes are not infective, that is, due to a living infective agent; it is probable that they are. The study of the nature of inflammation and of the process of infection are in reality to be conducted on the same lines, namely, that both are due to the introduction into the healthy organism of a harmful agency, which may either remain localised in its action, or may become generalised.

The cells which act as phagocytes are derived from the middle layer of the embryo (mesoderm), and are some varieties of leuco-

cytes, the endothelial cells of the vessels, and the elements of the splenic pulp. The endothelial cells possess the power of contractility in many animals. In leprosy they not uncommonly contain large masses of the bacillus lepræ. In rabbits inoculated intravenously with the bacillus tuberculosis, these cells take up the bacillus; a similar phagocytosis occurs in swine-erysipelas. The endothelial cells and the elements of the splenic pulp are also macrophages, which will be described immediately.

Varieties of Leucocytes.—There are four chief varieties of leucocytes which exist in the blood and lymph of vertebrate animals.

1. *Lymphocytes,* characterised by the presence of a single round nucleus, surrounded by a thin layer of protoplasm, which is stained slightly by aniline dyes, while the nucleus is deeply coloured (fig. 120, *a*).

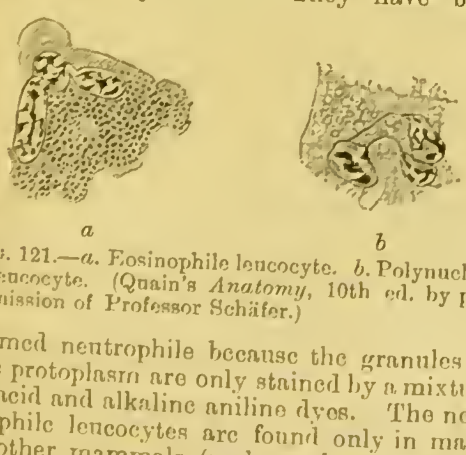
a *b*

Fig. 120.—*a*. Lymphocyte. *b*. Mononuclear leucocyte.

2. *Mononuclear leucocytes — Macrophages.*—These also possess a single nucleus, but the protoplasm surrounding it is greater in quantity than in the lymphocytes; both nucleus and protoplasm are well stained by aniline dyes (fig. 120, *b*).

3. *Eosinophile leucocytes* (Ehrlich).—These possess a lobed nucleus, but are characterised chiefly by the characters of the surrounding protoplasm, which contains large granules stained only by acid aniline dyes (such as eosin), and not by the alkaline ones (such as methylene blue, basic fuchsin, &c.) They are formed in the bone-marrow (fig. 121, *a*).

4. *Polynuclear* or *Neutrophile leucocytes—Microphages.*—These possess either a lobed nucleus or several nuclei, sometimes joined by filaments; the form of nucleus or nuclei is very varied. They have been



a *b*

Fig. 121.—*a*. Eosinophile leucocyte. *b*. Polynuclear leucocyte. (Quain's *Anatomy*, 10th ed. by permission of Professor Schäfer.)

termed neutrophile because the granules of the protoplasm are only stained by a mixture of acid and alkaline aniline dyes. The neutrophile leucocytes are found only in man; in other mammals (such as the rabbit and guinea-pig) their place is taken by the amphophile or pseudo-eosinophile leucocytes (fig. 121, *b*).

They are by far the most numerous of the varieties of leucocytes, forming three-fourths of the total number.

Of these varieties only the mononuclear and the neutrophile leucocytes act as phagocytes; and the former may also engulph the neutrophile leucocytes when these are dead or dying.

Leucocytes can digest suitable particles taken into their substance. Their digestive power is a property inherent in all original cells. In some cases of infective disease, the living bacteria have been observed to undergo this digestion in the phagocyte; they lose their protoplasm, leaving the investing membrane, which also finally disappears; and they also lose the property of being stained by some aniline dyes, such as vesuvine. Examples of this are found in recurrent fever in the ape, and in the streptococcus erysipelatis in man (Metchnikoff). Some of the bacteria may be digested and others not, the latter infecting the organism generally. This has been observed in tuberculosis and in swine-erysipelas.

It has been a question whether the bacteria taken in are living or not; but it has been proved by Metchnikoff that they are in many cases not only living, but virulent, since a single phagocyte of a pigeon (an animal refractory to anthrax) containing anthrax bacilli has been separated, and the bacilli cultivated in a suitable medium, proving on inoculation fatal to mice, &c.

The two varieties of leucocytes which act as phagocytes appear in some instances to be selective in their action. Thus in man it is the neutrophile leucocyte which takes in the streptococcus erysipelatis and the gonococcus; the mononuclear leucocyte remaining inactive. On the other hand, the mononuclear leucocyte is the phagocyte of the bacillus lepræ; the neutrophile variety remaining inactive.

Instead of digesting the bacterium, the phagocyte may prevent it developing. Thus the spores of anthrax injected into fowls and frogs (which are refractory to the disease) commence to germinate, but are taken up by the leucocytes. If, however, the body-temperature of the fowl be lowered by cooling the animal, or that of the frog increased by warming, the activity of the leucocytes is diminished, and the spores then germinate rapidly, the bacilli invading the whole body.

In other cases the leucocytes do not take in the infective agent, as in mice and guinea-pigs infected with anthrax, and in pigeons and rabbits infected with fowl-cholera; and according to Metchnikoff the more virulent the infection, the less phagocytosis occurs.

Why the leucocyte, possessing as it does the property of absorbing solid particles, refuses in one instance to act as a phagocyte,

or why in another only one variety of leucocyte acts as a phagocyte, although both are present, is perhaps in part explained by what has been described as *chemiotaxis* (*see* IMMUNITY). Certain substances have the power of attracting leucocytes, others do not possess it—positive and negative chemiotaxis. Thus most bacteria, living or dead, papain, and leucin attract leucocytes; while the most virulent bacteria, strong solutions of sodium and potassium salts, alcohol, chloroform, glycerine, bile, quinine, and jequirity repel them. Some substances act in a neutral manner. Buchner separated what he called 'proteins' from the bodies of dead pathogenic bacteria, and found that these 'proteins' were very active positive chemiotaxic agents. These 'proteins' have at present no chemical significance.

Chronic infective processes.—The best examples of such processes are tuberculosis and leprosy. The formation of miliary tubercle has been ascribed to the proliferation of the fixed cells of the organ affected, that is, the alveolar cells of the lungs, the hepatic cells, &c.; leucocytes playing but little part in the formation. This is the view usually held. From a study of tuberculosis in the early stage, produced by the intravenous injection of the bacillus in rabbits, Metchnikoff has concluded that in the liver the tubercle is formed not by the hepatic cell, but by the phagocytes: the mononuclear leucocytes and the endothelial cells. The agglomeration of phagocytes forms the tubercle, the fusion of some of the cells forming giant-cells; the tubercle nodule is therefore purely mesodermic in origin, and is produced by the phagocytes accumulating to attack the bacilli. The polynuclear leucocytes readily absorb the bacilli, but soon die, being absorbed by the mononuclear leucocytes (the macrophages). The macrophages are more resistant to the bacilli, and may destroy them. In leprosy, also, Metchnikoff considers that the cells containing the bacilli are phagocytes struggling against their invasion; the leprous nodule would thus be ranged with the tuberculous nodule as one of purely mesodermic origin.

The facts discovered by Metchnikoff have a clear bearing on the phenomena of inflammation, and are to some extent explanatory of them. For fuller details of the relation of phagocytosis to the inflammatory process his work, already quoted, must be referred to.

The writer is much indebted to M. Metchnikoff for revising this article and for his valuable suggestions.

SIDNEY MARTIN.

PHANTOM TUMOUR. — SYNON.: Hysterical Tympanites; Spurious Pregnancy.

DEFINITION.—A peculiar enlargement of the abdomen, occurring in females belonging more or less distinctly to the hysterical class. It is supposed by the patient to be an actual tumour, or to be due to pregnancy, but it can be made at once to disappear by placing her under the influence of chloroform.

DESCRIPTION AND DIAGNOSIS.—The phantom tumour is characterised by a more or less general prominence of the abdomen forwards, varying in degree. The enlargement may attain a considerable size, but is always quite symmetrical. The projection is most marked about the middle of the abdomen, and usually a depression or constriction is observed below the chest and above the pubes. It is rounded, smooth, and quite regular, presenting a uniform soft feeling, quite distinct from that of gaseous distension, fluid accumulation, or a solid mass. The enlargement is peculiarly movable, as a whole, from side to side. There is no sense of true fluctuation. Percussion yields a resonant note, but not usually excessive, and it may be of a muffled character. On examination *per vaginam* nothing abnormal can be detected, such as would be associated with ovarian or uterine enlargements, or with pregnancy. Should there be any doubt whatever as to the nature of the supposed tumour, it may be at once cleared up by placing the patient under the influence of chloroform or other anæsthetic, when the swelling immediately disappears, the abdomen becoming quite flat; but it gradually returns, even before the patient returns to consciousness, on the removal of the anæsthetic. There is no pain or tenderness in connexion with the enlargement; nor are any symptoms due to pressure or other causes observed: while the patient usually presents distinct signs of the hysterical condition. There ought, therefore, to be no difficulty in the diagnosis of a phantom tumour. What is the actual cause of the enlargement is by no means clear, but most probably it is due to a kind of paralysis of the intestines depending upon disordered innervation.

TREATMENT.—In a patient having a phantom tumour, the general and medicinal treatment for hysteria is that principally called for. She should be constantly impressed with the fact that the enlargement is not really a tumour, and is of no consequence. The condition is by no means easy to get rid of, but for this object galvanism may be applied to the abdomen, or, in obstinate cases, the patient may be put repeatedly under chloroform. The use of pressure, by means of an abdominal bandage or elastic apparatus, might be serviceable in some cases. The bowels should be kept freely opened.

FREDERICK T. ROBERTS.

PHARYNX, Diseases of.—The pharynx is often involved in acute general diseases which affect the throat, such as scarlatina and diphtheria; or it may be im-

plicated along with other structures in diffused inflammation of the throat, ulceration, gangrene or morbid growths; but the diseases of practical importance connected with the pharynx itself which need to be discussed here are three—namely (1) **Acute inflammation**; (2) **Chronic inflammation**; and (3) **Follicular inflammation.**

1. Acute Inflammation of the Pharynx.—Synon.: Fr. *Pharyngite Aiguë*; Ger. *Acute Schlundkopfentzündung.*

Definition.—An affection of the pharyngeal mucous membrane, characterised by a non-exudative catarrhal inflammation.

Ætiology.—Some persons, though otherwise robust enough, show a particular predisposition to pharyngeal catarrh; and previous attacks seem to increase the predisposition. The young are, on the whole, more liable to the complaint than those more advanced in age; while all that brings the strength of the individual below par, whether over-work, exposure, or disease, more particularly of a specific nature, acts as a predisposing cause. Two of the most common exciting causes are cold and damp. At other times it may take origin in an extension of the catarrh from other organs, in a blood-poison, or in a direct irritant.

Symptoms.—Most frequently, though not universally, the attack is ushered in by a certain amount of fever. The patient experiences some degree of chilliness, if not actual rigor; he is restless; his temperature is raised; the skin is dry; and languor and stiffness of the body are complained of. This may precede the pharyngeal symptoms by some hours, but soon these begin to arrest attention. The patient discovers in his throat a feeling of dryness, soreness, or fulness, speedily amounting to pain. This is particularly noticed when an attempt is made to swallow. And yet this very condition of dryness of the throat provokes him to renew the effort to swallow, the unpleasantness of which he manifests to the bystanders by the wry faces thereby induced. This desire to swallow is greatly aggravated if the uvula happens to be involved in the catarrh, as from its swollen and often œdematous condition it suggests the presence of a foreign body, of which the patient endeavours to rid himself by repeated swallowing. Cough is a frequent accompaniment, especially if the inflammation have extended downwards.

The inflammation may not extend into the larynx, but more usually this part is involved; and then the voice is altered in tone, becoming husky or hoarse, and it acquires the well-known 'nasal twang,' or it may become entirely toneless. On inspecting the throat, it will be observed that the mucous membrane is considerably altered in appearance and colour, being tumefied and redder than in health. At first it is dry, often glistening, tense, and extremely irritable. But as the case progresses this condition is altered, a secretion, more or less abundant, being poured out, bathing the tonsils and posterior parts of the pharynx with a muco-purulent discharge. This gives rise to repeated hawking and attempts to expectorate. Occasionally this catarrhal inflammation extends into the Eustachian tubes, exciting considerable deafness, and pain in the ears when the middle ear is involved. At the same time the oral mucous membrane is affected, as evidenced by the usual symptoms of foul tongue, bad taste in the mouth, accumulation of saliva, and offensive breath. This acute variety, under effective treatment, usually subsides within a week.

Treatment.—Dr. Ringer urges the use of tincture of aconite, in drop doses every quarter of an hour for the first two hours, and afterwards hourly, if the angina has been seen at the very commencement. He states that the inflammation rarely fails to succumb to this treatment in twenty-four to forty-eight hours. The patient should be confined to bed; a brisk purgative administered; and bland nourishment allowed, including abundance of milk, ice *ad libitum*, and stimulants if called for. Warm fomentations or poultices may be applied externally, or a wet compress. Steam may be inhaled, and a warm spray, medicated with morphine, or concentrated solution of phenazone, thrown into the throat every two hours. The parts may be painted once daily with a solution of nitrate of silver (gr. 40 to ℥j). Cocaine pastils may be cautiously sucked to relieve pain. When the swelling and redness subside, and the parts no longer present the dry, tense appearance, but are covered with mucus or pus, then is the time to bring in the astringent gargles, or to paint the throat with glycerine of tannic acid, and to use guaiacum or krameria lozenges. And now, also, tonics will prove useful.

2. Chronic Inflammation of the Pharynx.—This is by no means an uncommon affection, and may exist without having passed through the acute form.

Symptoms.—As in the acute variety, so here, there is considerable difficulty in swallowing, amounting even to pain when irritating substances are attempted to be passed into the gullet, but of course in a much less degree. Persons suffering from this form of sore-throat are specially liable to exacerbations of the catarrh, giving to the affection more of a sub-acute character, and then their usual symptoms are all aggravated. The hawking and expectoration, which habitually go on, more or less, during the whole time of their toilet-making, are increased; and as they find some difficulty in removing the tough mucus from the back of the throat, the hawking is continued till the mucous membrane itself is strained, and some of the

ramifying vessels give way, and the patient is alarmed to see blood mixed with the expectoration. In some instances, especially in the case of those who are habitual topers, this hawking in the morning is the prelude to the morning vomiting. The voice is apt to be husky, more particularly if the catarrh have at all invaded the larynx. On inspection of the throat, it will be observed that the mucous membrane is more or less reddened; it presents a roughened appearance; and is sometimes puffy-looking, with numerous veinlets running across it, and a quantity of mucus adhering to the posterior part of the throat: the last appearance is more common in the relaxed condition of the throat. This variety is not infrequently found as an accompaniment of other diseases — phthisis, syphilis, disorders of the stomach, and gout; and as an effect of intemperance. The affection is usually very obstinate.

Treatment.—If the disorder be dependent upon any other affection, such as gout, rheumatism, or lithæmia, then of course the primary disease must be treated. But in the case of simple chronic pharyngitis it will usually be found that the sufferer is considerably below par in his general health. This indication must be met, and the patient supplied with tonics; his habits of life altered, his business suspended, and much out-of-door exercise enjoined. Good nourishing diet should be ordered. Smoking must be entirely prohibited, or much reduced. Locally, the affection is best treated by sprays or swabbing. Gargles seldom reach the parts; but if they are to be used, the best are those of alum, tannin, chlorate of potassium, and bromide of ammonium. The last is especially valuable in relaxed throats, with elongated uvula and irritable cough. As sprays, the most valuable are solutions of the following in distilled water, in the proportions indicated to the ounce: Tannin, 5 to 15 grains; alum, 10 to 30 grains; sulphate of zinc, 5 to 10 grains; common salt, 10 to 30 grains; and glycerine diluted with water. In swabbing the throat, glycerine of tannin may be used, Lugol's solution, or the simple tincture of iodine. Inhalation of chloride of ammonium in the gaseous form from a suitable apparatus is occasionally beneficial. In some cases mineral waters are prescribed with success.

3. **Follicular Inflammation of the Pharynx.**—Synon.: Granular Pharyngitis; 'Clergyman's Sore-throat'; Fr. *Angine Glanduleuse*; Ger. *Chronische Pharyngitis.*

This is another, by no means rare, form of chronic pharyngitis. On inspecting the throat of a sufferer from this affection, the posterior wall of the pharynx will be seen to present a mammillated appearance. The mucous follicles are much more prominent than is usual in health, and seem as if distended with their proper secretion. The submucous tissue, in which they are imbedded, is also thickened and hypertrophied. Occasionally these tubercles coalesce, and then a large confluent prominence is observed, studding, here and there, the posterior wall of the pharynx. In addition to the distension of these follicles, in some cases a large secretion of mucus is poured out, which, especially at night, hardens and concretes, and presents a dry, ugly, greenish-coloured crust on the back of the pharynx.

At other times there is, on the contrary, a deficiency of mucus, and then there is observed a dry varnished-like appearance of the back of the throat.

Symptoms.—Each of these conditions gives rise to a considerable amount of coughing and hawking; more particularly is this the case when the adherent mucus is tough, tenacious, and difficult of expectoration. The voice becomes hoarse and husky, this being very observable after any continuous effort at speaking or reading. Swallowing is not attended with difficulty or pain. But the presence of these enlarged follicles in the throat suggests to the mind of the patient the necessity of swallowing, and consequently he makes frequent uncalled-for attempts to swallow. At the same time he perceives a sensation of dryness or pricking in the throat. Those who are the subjects of this disorder will generally be found to be those who strain their voice—often clergymen —and hence the erroneous name for the affection of 'clergyman's sore-throat'; or those whose bodily and nervous energy have been in any way reduced. It is a tedious disorder, often lasting for years. There seems to be small disposition for the disease to extend to the larynx or lungs; but on examination by means of the rhinoscope, the same enlarged appearance of mucous follicles may, in some cases, be seen to extend to the utmost limits of the pharynx, and the mucous membrane is itself tumefied and thickened. If this condition be neglected, it may ultimately proceed a stage further, and the character of the secretion become altered, presenting a mucopurulent appearance, while the glands themselves become indurated and, in some cases, ulcerated. Occasionally it will be found that the mucous membrane and the follicles of the larynx take on the same form of chronic inflammation, especially when the disorder is persistently ignored for years. Arrived at this stage, the general symptoms become so aggravated as to forbid the patient, or his friends, any longer to neglect the disease. The hoarseness, always present in a certain degree in speaking or singing, becomes constant and intensified; and if the larynx be considerably affected, there may be complete aphonia. And now more decided pain is complained of, and the individual no longer exhibits the same alacrity and interest in the pursuit of his avocations, but becomes indifferent to them, in consequence of the in-

creased debility and general languor which pervade his whole system. Cough, however, is not a striking symptom, if the disease do not invade the larynx to any great extent, and its tendency is rather to progress upwards than downwards. The other structures in the neighbourhood of the pharynx become implicated, when the disease assumes the ulcerated form; and the uvula, tonsils, and soft palate become tumefied, swollen, elongated, and generally so enlarged as greatly to interfere with the inspection of the parts. The epiglottis also exhibits, in severe cases, a tendency to become crooked and ulcerated.

Treatment.—The general rules already laid down with regard to the treatment of chronic pharyngitis apply equally in this disorder, only, perhaps, with greater force. The constitutional treatment must be more decided. The constitution must be braced in every possible way, by the use of generous diet, tonics, bathing, and travelling. And to further the cure of the affection, attention must be paid to the secretions generally, these being stimulated or altered by the exhibition of small doses of blue pill, podophyllin, and aloes. Iodine in some form should be given. But the local treatment is equally, if not more, important, and to be effective must be regularly and conscientiously persevered in for months. There are various methods of carrying out this, by inhalations of medicated fluids, or the insufflation of various powders, as alum or tannin. The most certain and efficacious means, however, because at once reaching the affected parts, and producing decided and visible effects, is the destruction of the follicles which are the seat of the disease. This is best effected by the use of the galvano-cautery to each of the follicles, not more than four or five being treated at a sitting. If this be not possible, then certain remedies may be directly applied to the diseased parts by means of a large camel's-hair brush. One of the best of these applications is a strong solution of nitrate of silver, varying in strength from twenty to sixty grains to the ounce of distilled water. If the parts be much ulcerated, a still stronger solution may be employed. Other medicaments which may at a later stage be used are the glycerine of tannin, or a solution of tannin in water (equal quantities of tannin and water), bromide of ammonium, tincture of iodine, or nitrate of uranium. Of course it must be left to the discretion of the practitioner to decide how often he should repeat these strong applications, as it all depends upon the nature of the case; but as a general rule it may be laid down that once every second day will be quite sufficient for the first fortnight, and after that two or three times a week will be often enough. This is to be kept up till the nodulated appearance is got rid of. As soothing applications the glycerine of borax will be found valuable, or glycerine alone, or olive or almond oil. Gargles are useless, as they never reach the affected parts. A course of mineral waters is sometimes of the greatest value. *See* Mineral Waters.

Claud Muirhead.

PHIMOSIS (φιμόω, I confine).—Synon.: Fr. and Ger. *Phimosis*.—A morbid condition of the penis, in which the glans cannot be sufficiently uncovered, on account either of congenital smallness of the orifice of the prepuce, or of disturbance of the natural relations between the latter and the glans by disease. *See* Penis, Diseases of.

PHLEBECTASIA (φλέψ, a vein; and ἔκτασις, extension).—Synon.: *Hypertrophia venarum*.

Definition.—An increase or spreading of veins, especially applicable to the minute venules of the cutaneous or mucous surfaces.

Description.—Phlebectasia is sometimes congenital, as when it gives rise to venous nævus; and at other times accidental, proceeding from relaxation of the tissues, or obstruction of the venous circulation. Phlebectasia, from want of tone of the tissues of the skin and weak contractile energy of the vessels, is most frequently met with on the cheeks and nose; whilst that which results from venous obstruction occurs generally upon the lower limbs. On the nose it is associated with small venous trunks which carry the returning blood into the deeper venous plexuses, and are very conspicuous.

Treatment.—The treatment of phlebectasia consists in improving the tone and vigour of the skin, removing palpable causes of obstruction, and applying local astringents. When torpid action is the chief cause, as happens in accidental phlebectasia of the face, daily friction with sulphur ointment is useful in exciting an improved nutritive vigour. Where large venules are present, as on the nose, they may be obliterated by a careful touch with potassa fusa, which forces the blood to seek a deeper channel. In phlebectasia of a nævous character a good method of treatment consists in painting the surface night and morning with solution of subacetate of lead. But the capillary venous hypertrophy of varicose or obstructed veins could only be benefited by the removal of the cause.

Erasmus Wilson.

PHLEBITIS (φλέψ, a vein).—Inflammation of a vein. *See* Phlegmasia Dolens; and Veins, Diseases of.

PHLEBOLITH (φλέψ, a vein; and λίθος, a stone).—A concretion formed in a vein. *See* Veins, Diseases of.

PHLEBOTOMY (φλέψ, a vein; and τέμνω, I cut).—A synonym for venesection. *See* Blood, Abstraction of.

PHLEGM (φλέγω, I burn; I am inflamed).—A popular name for sputum or expectoration. *See* EXPECTORATION; and SPUTUM, Examination of.

PHLEGMASIA DOLENS (*phlegmasia*, inflammation; and *dolens*, painful).—SYNON.: *Phlegmasia Alba Dolens*; Pop. White leg; Fr. *Phlegmasia Alba Dolens*; Ger. *Phlegmasia Dolens*.

This is a disease having very distinct characters and easily identified. It has, therefore, been long familiarly known both to the profession and the public. Except in lying-in women, it is uncommon, few medical men seeing well-marked or characteristic cases of it under any other circumstances; and it is for the most part as a disease of the puerperal state that it has been the subject of study and investigation.

ÆTIOLOGY.—Phlegmasia dolens affects both sexes, and no age is exempt from it. It may attack any part of the body, but one or other of the lower limbs is the ordinary seat of the disease. Occasionally it seizes one lower limb first and then the other, or may extend from the one to the other. The well-characterised disease, as it affects lying-in women, is an affection of one or other of the lower limbs, very rarely of both. The left leg is far more frequently affected in the puerperal state than the right; and the left leg is supposed to be more frequently affected than the other under whatever circumstances the disease occurs. In lying-in women the comparative frequency of this affection, and of several other morbid conditions on the left side, is believed to depend on the circumstance that the parts on that side of the pelvis are more frequently subjected to pressure and bruising than the parts on the other side. This probably arises from the comparative frequency of the right lateral obliquity of the uterus throwing the direction of the uterine power of labour across the mesial line to the left side of the pelvis. The disease affects multiparæ more than primiparæ. It is prone to recur in successive confinements.

From the variety of circumstances under which phlegmasia dolens may occur, it will be easily apprehended that it may arise in any period of pregnancy or of the puerperal state, but the usual time of its appearance in lying-in women is the second week after delivery. It rarely commences in the first week, less rarely in the third; seldom subsequently, in the puerperal state.

The special proneness of lying-in women to this disease probably depends on the hydræmia which prevails during pregnancy, and on the natural formation of thromboses in the uterine sinuses at its termination.

Besides the puerperal state, other conditions render the body liable to phlegmasia dolens. Among these are convalescence from fever—especially typhoid, dysentery, disease of the rectum, malignant disease of the uterus, uterine fibroids, arrestment of menses, and malignant and tubercular disease generally. The complaint has been frequently observed to affect the leg of the side corresponding with a previously commenced pleurisy. Occurring in connexion with any of these conditions, the disease may vary greatly in severity, from being scarcely recognisable to its utmost degree of intensity. But its liability to severity is not the same in all circumstances. For example, in connexion with malignant diseases of the womb it is often very slight and chronic.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances referable to phlegmasia dolens vary, especially in the presence or absence of thrombosis of the veins. Phlebitis and thrombosis are, however, generally found, with more or less associated inflammation of connective tissue and of the lymphatics. The intravenous blood-clots vary in extent, sometimes occurring as high as the vena cava inferior. They vary in appearance, being more or less decolorised, more or less softened, or even in parts diffluent. They may be adherent to the veins, partially organised, or separable from them. They may entirely block the veins, or may allow the passage of blood between them and the wall of the vein or through their substance as by a tunnel. In recent cases the clot adheres to the internal coat of the vein, which is blood-stained. The coats are thickened and inflamed, and the surrounding cellular tissue is also sometimes specially hardened. In cases complicated with pyæmia there may be found suppuration of the clots, and other appearances observed in that condition.

PATHOLOGY.—Various theories, which reflect the pathology of the times at which they appeared, have been held concerning the nature of phlegmasia dolens. The disease was ascribed to a metastasis of lochia by many pathologists, and by others to a metastasis of milk. These views had no basis of facts, or very little; they rested almost entirely on authority, and disappeared as pathology improved. The discovery of the lymphatics in the last century led to the first attempts of a truly scientific kind to solve the mystery of the nature of this affection, the suggestion being that it arose from their injury and obstruction. But considering how imperfect is our acquaintance even now with the origin and distribution of these vessels, with the circulation through them, and with the effects of their injury or obstruction, we must still seek for information. The next attempt to account for this disease was based on the important discovery of the thrombosis of the veins of the affected limb. This was erroneously assumed to be an invariable or essential condition of the disease, which was accordingly now regarded as phlebitic. But

the occurrence of the lesions regarded as essential, the phlebitis and thrombosis, without the development of the characteristic appearances of the affected limb; and, on the other hand, the occurrence of the characteristic appearances without the simultaneous presence of the phlebitis and thrombosis, demonstrated the insufficiency of the phlebitic theory. The next theory to be mentioned is a sort of retrogression to humoral pathology. It alleged that a morbid condition of the blood, of undefined nature, is, along with phlebitis and thrombosis, necessary for the production of the disease. This theory is nearly as deficient in basis as the lochia or milk theory. The confirmatory experiments on the lower animals, by injecting lactic acid into the circulation, are in the highest degree insufficient; and this theory leaves unexplained important points, such as the seat of the affection. The last theory to be mentioned is now very widely held to be the true one. It is that the disease, as it is seen in lying-in women, is essentially a parametritis, probably of septic origin—that is, an affection of the cellular tissue, commencing, indeed, in the close neighbourhood of the womb, but extending to remote parts, and, it may be, prevailing in them, while the original inflammatory affection of the womb and its immediate neighbourhood has diminished, or even disappeared. Parametric inflammation extends in a similar manner occasionally as far as the cellular tissue around the kidney. When it extends to a limb, it is believed to be the cause of the phlegmasia dolens, and to have the phlebitis and lymphangeitis with their secondary thromboses as its consequences. This theory is to a certain extent an old one in modern habiliments.

The great barrier to progress in our knowledge of the nature of phlegmasia dolens is the rarity of necropsic investigations, and the sometimes doubtful character of the evidence they afford. Very few unexceptionable *post-mortem* investigations have ever been made in this disease. Such a *post-mortem* inspection must be made in an early stage, and in a patient dying accidentally from some cause unconnected with the disease of the limb. Now, the disease is not only not fatal in an early stage, but it might be asserted that by itself it is not fatal at all—that death, apparently from it, occurs only in complicated cases—in such as run an extraordinary and rare course. In the meantime, then, no theory of the disease can perhaps be regarded as yet absolutely established.

Symptoms.—As a rule, phlegmasia dolens is preceded by a slight access of feverish phenomena, seldom by a distinct rigor. There is also sometimes an indefinite malaise for a day or two, before the pain in the limb is complained of. Another premonitory symptom is described, but it is certainly not always present—namely, pain and tenderness in the region of the womb, especially affecting that side of it corresponding to the limb about to be swollen.

The first definite announcement of the disease is generally acute pain along the course of the femoral vein, or in the calf, or above the ankle. In these situations the thrombosed vein can frequently be felt, but not invariably, for sometimes the tenderness, sometimes the swelling, prevents its being made out; and sometimes this thrombosis is absent, at least in parts where it can be felt through the skin. Soon the pain and tenderness extend over the whole affected parts, which may be the whole limb, and often a feeling as of aching in the bones is complained of. The pain is sometimes along the internal saphena vein, which may be traced by the finger till it dips to join the femoral.

Simultaneously with the complaint of pain, or within a day or two after it, swelling appears, which gradually spreads and increases in hardness. This swelling is not like ordinary œdematous or anasarcous swelling in the sensation it communicates to the hand of the physician, or in the history of its commencement and progress. When it commences, and again as it disappears, it may be, comparatively to its perfect state, soft, and it may pit on pressure; but when, a few days after its appearance, it is fully developed, it is very tense, and nearly as hard as a solid india-rubber ball, and does not pit on pressure. The swelling may appear at once all over the limb, but frequently it commences above and spreads downwards. Sometimes the inverse course is followed. It not rarely affects only the lower parts of a limb, very rarely the upper parts only. It does not affect the posterior more than the anterior surface of the limb. It rounds off the figure of the limb, but does not distend the skin or destroy the form so entirely as anasarca. If the skin is pricked the exudation is a coagulable lymph. Occasionally there is an erythematous blush over parts of the limb; but this is not common, and it may be confined to a narrow surface along the course of a subcutaneous vein or lymphatic.

In a characteristic and fully developed case, such as is frequently observed in the puerperal state, the limb presents a remarkable appearance. The swelling affects the labium and hip and the whole limb, only rarely rising higher. The form of the limb is partly retained, but its features are all rounded and nearly lost in the swelling. Its colour is white, and hence the name occasionally used of 'white leg,' and formerly of 'milk leg,' when it was supposed to be due to a metastasis of milk. But besides being pale, it is glossy; or its surface resembles that of polished marble, and the disease is sometimes called 'marble

leg.' In the milder cases the swelling is less, and softer, and may be confined to a part of the limb.

The limb may be kept in an extended attitude, or it may be slightly flexed at the joints. Movement of it causes much suffering, and the power of voluntary motion is almost completely lost while the disease continues.

After the disease has lasted nine days or thereabouts, it generally makes no further progress, but recedes, the pain and swelling diminishing. The rate of this recession varies very much, being probably more or less directly in proportion to the restored permeability of the vessels. In a favourable case several weeks may elapse before the disease disappears, whilst in other cases the cure may be further or even indefinitely delayed. The temperature throughout rarely exceeds 102°, and is often less.

COMPLICATIONS.—The disease is sometimes complicated by other affections, or by aggravations of some of its conditions. Among such occurrences are inflammation and suppuration of the intrinsic joints of the pelvis, erysipelas, limited abscesses of periphlebitic origin, diffuse suppuration of cellular tissue, gangrene of any part or of a varying amount of the entire lower portions of the affected limb. These complications or aggravations cause much danger to life, and in this respect their influence varies according to circumstances. But there are other complications or aggravations which are more often fatal. They may be summed up in the terms 'embolism' and 'pyæmia,' and are the consequences, on the one hand, of detachment of a thrombus in the femoral, or in still larger veins, or, on the other hand, of a more slow breaking up of blood-clots into *débris*, more or less puriform, which enters the circulatory current, and induces a general toxæmia, septic or non-septic, according to the conditions under which the clots suppurate.

SEQUELÆ.—The most frequent sequela of phlegmasia dolens is persistent aching of the limb. This is liable to be increased by cold and damp weather, and by derangement of the general health, as well as by exercise. Another is a tendency to œdema of the ankles, more or less persistent. Sometimes the limb remains deficient in muscular power. Rarely, the limb is not only powerless but wasted. And in some very uncommon cases it is the subject of a great hypertrophy of the cellular tissue, simultaneous with muscular wasting; and this cellular hypertrophy may be complicated with more or less extensive and intractable ulceration. Such cases probably result from permanent destruction of large vascular areas.

DIAGNOSIS.—The diagnosis of phlegmasia dolens requires no discussion. The disease can scarcely be confounded with any other if its history is taken into consideration: only it is necessary to remember that œdema with phlebitis or accompanying varicose veins may somewhat resemble it.

TREATMENT.—The treatment of phlegmasia dolens should be both constitutional and local. The former will vary according to the circumstances of the case, and the views of the practitioner. In the early stage ammonia in effervescence, with quinine, according to the amount of pyrexia present and the general condition of the patient, and in the later stage iron, are generally useful, with as much sedative as may be indicated by the severity of the pain. Local treatment is very important. The limb is to be kept at rest, either in an extended or flexed position, as may prove most comfortable, and supported on a pillow raised at the foot, with the pressure of the bedclothes kept off by a cradle. Sometimes hot fomentations are most comfortable to the patient's feelings, but more frequently wrapping the limb in cotton wool sprinkled with equal parts of belladonna and chloroform liniments, with oil-silk outside, gives the greater relief. When the swelling is subsiding gentle bandaging with a light flannel bandage is very serviceable. Leeches are sometimes applied along the course of an inflamed vein, but their utility is, to say the least, doubtful. If the phlegmasia be associated with septicæmia, its general treatment will of course vary with the general treatment of the toxæmia.

After the acute stage of the disease is past, the sequelæ have to be dealt with. Of these the most frequent are aches, swelling, œdema, and muscular weakness; and for these the most efficient, but by no means invariably successful, remedies are frictions, bandaging, and faradisation. After all active disease has disappeared, and after danger of dislodging thrombi has passed, the patient may resume the use of the leg. No exact statement can be made of the time at which the danger of embolism is passed. It may prove suddenly fatal as late as thirty-seven days after delivery.

Persistent local hardness and tenderness, probably periphlebitic, may be treated locally by gentle frictions with a mixture of mercurial and belladonna ointments, but in using frictions of all kinds the danger of dislodging a thrombus is not to be overlooked. Internally, small doses of potassium iodide with quinine or iron are useful adjuvants.

J. MATTHEWS DUNCAN. HENRY GERVIS.

PHLEGMATIC TEMPERAMENT. *See* TEMPERAMENT.

PHLEGMON (φλέγω, I burn—as a medical term, glow, am inflamed).—SYNON.: Fr. *Phlegmon*; Ger. *Entzündungsgeschwulst.* The term 'phlegmon' is almost disused now in English medical literature. It is still employed by the French. Abernethy defines phlegmon as the 'most violent kind of inflammation,' 'attended with heat, redness,

throbbing, pain, and swelling,' such as 'generally takes place in a good constitution.' Older writers describe it as a 'tumour or apostume against nature, engendered of defluxion of blood, and of colour red and hard.'

Nélaton describes simple or circumscribed phlegmon and diffuse phlegmon. He says: 'Phlegmon is generally defined as inflammation of the cellular tissue; but surgeons have restricted the sense of the word, and only apply it to inflammation of the free cellular tissue, that is to say, of that which is placed immediately beneath the integuments or which surrounds the different organs.' The diffuse phlegmon of the French writers is the phlegmonous erysipelas of the English. *See* ERYSIPELAS.

MARCUS BECK.

PHLEGMONOUS.—A term applied to extremely acute inflammation of the cellular tissue, spreading widely, and accompanied by great exudation, with brawny hardness, intense redness, heat, and pain. If unrelieved by treatment, phlegmonous inflammation tends to terminate in gangrene. *See* ERYSIPELAS.

PHLYCTÆNA (φλύζειν, to be hot).—A small vesicle, containing an aqueous or serous fluid, and not exceeding in bulk the diameter of a pea, as in sudamina, miliaria, and herpes. The term is sometimes also used in connexion with ophthalmia. *See* EYE, AND ITS APPENDAGES, Diseases of.

PHLYCTIS (φλύζειν, to be hot).—A vesicle or blister, averaging in size the hemisphere of a hazel-nut or walnut, and filled with serous fluid. Phlyctis is the Greek synonym of bulla, and is applicable to the large vesicles or blisters familiar to us in pemphigus or pompholyx. *See* PEMPHIGUS.

PHLYZACIUM (φλύζειν, to be hot).—A hot or inflammatory pustule. The term 'phlyzacia' is applied to acute pustules with an inflamed base, such as those of ecthyma and small-pox.

PHOSPHATIC CALCULUS.—DESCRIPTION.—Phosphate of lime calculi are sometimes formed in the kidney, but much more frequently phosphatic stones are a secondary deposit on some pre-existing nucleus. They form dense or porous white layers, frequently showing the glistening crystals of the triple phosphate on the surface. Such masses are soluble in acids, insoluble in alkalis or water, friable, and fusible. They develop rapidly, and may reach an enormous size.

TREATMENT.—When of moderate dimensions, phosphatic calculi may be easily removed by lithotrity; but, as it is often difficult to ensure the removal of every minute particle, and as they are often accompanied by chronic cystitis and deficient expelling power of the bladder, recurrence is not infrequent, and the ultimate result unfavourable.

WILLIAM CADGE.

PHOSPHATURIA.—SYNON.: Phosphatic Diathesis.

ÆTIOLOGY.—Phosphoric acid in the urine is derived directly from the food, and also from oxidation of the waste albuminoid tissues of the body. The daily excretion by the kidneys amounts to about 50 grains, being greatest after the ingestion of food, and especially observed after indulgence in vegetable food.

CHARACTERS AND COMPOSITION. — Phosphoric acid in the urine is always found combined with potassium, sodium, calcium, magnesium, and ammonium. These salts, variously associated, are held in solution by the acidity of healthy urine, and this acidity is probably chiefly due to the acid phosphate of sodium. Where this acidity, from any cause, is greatly diminished or destroyed, then a deposit of the phosphates takes place; but this deposit by no means shows that any excess is present. Careful quantitative analysis, under strict precautions as to diet, can alone detect excess or deficiency; but, clinically, this is of less consequence in that no constant symptoms are produced by excess or deficiency, and the real importance to the practitioner lies only in the fact of feebly acid or alkaline urine leading to deposit of phosphates.

The two most common forms of phosphatic sediment are—(1) the *triple phosphate of ammonium and magnesium*; and (2) the *amorphous phosphate of lime.*

1. The *triple phosphate* crystallises in the form of transparent triangular prisms with bevelled ends. The deposit has a white appearance, but more frequently it shows as a slight flocculent cloud in the urine, resembling mucus, or as an iridescent pellicle on the surface. The urine is either faintly acid or alkaline; and boiling gives rise to an opaque cloud, which is instantly dissolved by a drop of nitric acid. It not infrequently co-exists with deposits of uric acid, urates, or oxalate of calcium; and also in dense urine with an excess of urea.

2. *Amorphous phosphate of lime* is only found as a deposit in alkaline urine. Microscopically it shows as pale granules or spheroids, sometimes resembling the dumb-bells of oxalate of calcium, sometimes the pale urates.

A third form of phosphatic deposit, the *stellar phosphate of lime*, is but rarely met with. It was first noticed by Dr. Hassall, who considered it to be a biphosphate; it crystallises in minute rods, which are gathered into sheaf-like bundles, or grouped in stars

and fans. The clinical importance of this deposit is not well understood. Sir William Roberts has met with it in cases of diabetes, phthisis, and chronic rheumatism; and the writer has recently found it in a diabetic patient, and also in one convalescing after ovariotomy.

Symptoms.—Deposit of phosphates takes place in many diseases—diseases often of an opposite character, and having no pathological resemblance—for example, in acute cerebritis; towards the close of cases of pleurisy, pneumonia, and rheumatic fever; in certain periods of typhoid fever; and in acute mania. But it may be taken as proved that there is no morbid condition, characterised by definite and constantly occurring symptoms, and accompanied by the deposit of phosphates in the urine, which can be entitled to the designation of a 'diathesis.' Prout's description of phosphatic diathesis is merely that of ammoniacal urine. Golding Bird associated the deposit with symptoms of irritative dyspepsia, hypochondriasis, and temporary exhaustion of the nervous power; symptoms which are not unlike those said to be characteristic of the so-called oxalic acid diathesis. Remembering, however, that phosphatic deposit does not necessarily or frequently mean excess, but depends on diminished acidity or on alkalinity of the urine, it will be more profitable to notice this condition.

The urine becomes neutral or alkaline from the presence of either fixed alkali—potash and soda, or of the volatile alkali—ammonia. The continued or frequent presence of alkaline urine from *fixed alkali* denotes grave disorder, generally characterised by debility, anæmia, and nervous dyspepsia; it may and does occur in the course of many, even acute, diseases; it represents an altered condition of blood and nutrition; but it is not typical of any one malady or diathesis, nor, so far as analytical investigations have yet gone, is there any clear evidence of the truth of the theory that excess or deposit of phosphates and alkaline urine are the result of increased cerebral action or of brain-disease.

Urine rendered alkaline from *carbonate of ammonium* is always accompanied by deposit of both forms of the phosphates. The alkalinity is the result of decomposition of the urea; there is the peculiar ammoniacal odour, reaching sometimes to intense putrid fœtor. This decomposition is believed to be due to the presence and action of a specific micro-organism (*bacterium ureæ*) which acts as a ferment, and causes the urea to split up into carbonate of ammonium and water. This bacterium is probably introduced through the catheter, but the change may occur in those for whom a catheter has never been used, and in them it is supposed that the bacteria may find their way along the mucous membrane of the urethra, or through the medium of the circulation. Ammoniacal urine is always indicative of lowered vitality, either from age or disease, or spinal injury; it points to no altered condition of blood or constitution, but is the result of local disease. The phosphates which are so freely thrown down are the triple phosphate and the amorphous phosphate of lime; they are readily deposited on any pre-existing nucleus, whether it be a stone, a clot of blood, a roughened ulcerated portion of bladder, or any foreign body; but without this pre-existing nucleus it but rarely, if ever, happens that concretions form.

Treatment.—As there is no real phosphatic diathesis requiring special management, it follows that the treatment should consist in removing the cause of the alkalinity of the urine from *fixed* alkali. The two most common causes are dyspepsia and nervous and general debility. In those cases of chronic vomiting and irritable dyspepsia in which the urine loses and recovers its acidity several times daily, no special remedies addressed to the state of the urine can be of any avail. The mineral acids have long been relied on for restoring the natural acidity of alkaline urine; it seems certain, however, that they have no special or direct influence, but simply act beneficially by their indirect tonic effect on the system. Phosphoric and benzoic acids may slightly add to the acidity of the urine, and opium and belladonna in certain conditions of nervous irritability are known to have the same effect; but, speaking generally, the mineral, vegetable, and acid tonics are required in almost all cases, and with them the usual adjuncts, namely, good air and exercise; the cold sea-water bath; a well-selected generous diet, largely composed of animal food; and relief from anxiety or over-work.

For alkalinity and phosphatic deposit depending on *volatile* alkali, it must be remembered that in this state the urine is almost always secreted acid. The local disease which causes it must, if possible, be remedied: a stone should be removed; an atonic bladder emptied at stated intervals by the catheter, and washed out with antiseptics, if necessary. But the strength is always to be upheld by rest, good diet, and tonics.

William Cadge.

PHOSPHORUS, Poisoning by.—Synon.: Fr. *Intoxication Phosphorée*; Ger. *Phosphorvergiftung.*

Phosphorus acts as a poison only when in the form of yellow, common, or soluble phosphorus; in the allotropic form of red or insoluble phosphorus it is generally thought to be inert, but this is doubtful. Poisoning by phosphorus may be (1) *acute* or (2) *chronic.*

Acute poisoning by phosphorus has recently become not uncommon in this country. On the Continent phosphorus, in the form of the tips of lucifer matches, is frequently used

for suicidal purposes. In England phosphorus is most commonly taken in the form of 'rat paste' or 'phosphorus paste,' a vermin-destroyer composed of butter or other fats and phosphorus, coloured with Prussian blue. Chronic phosphorus-poisoning from the inhalation of phosphorus vapours has long been recognised.

Anatomical Characters.—These are well-marked, and consist of extreme fatty degeneration of the liver, and frequently also of the gastric mucous membrane, kidneys, and cardiac muscular fibre. The liver is also greatly enlarged and white; and the organ frequently takes fire on the mere application of a spirit-lamp flame. On microscopical examination the organs affected are seen to be infiltrated with granular fatty matter, soluble in ether; the gastric tubuli are also filled with granular fat; and the striated muscular fibre has more or less completely lost its normal appearance, and been converted into a similar granular material.

Symptoms.—1. *Acute Phosphorus Poisoning.*—When a phosphorus mixture is swallowed a disagreeable taste is perceived, which is occasionally followed by a burning sensation in the throat, gullet, and stomach, and speedy vomiting. But these signs of the local action of the poison may be either absent or altogether inconsiderable. At any rate, as a rule, these and the diarrhœa and colicky pains described by some writers, soon pass off, leaving the patient apparently nearly well; though a careful examination may reveal a small, feeble pulse, and when the patient is questioned, the existence of obscure wandering pains may be admitted. In the course of a few days—usually two, three, four, or five—the patient becomes listless, dull, and slightly jaundiced. There is much headache and sleeplessness, together with a general febrile condition, gradually passing into a 'typhoid' state; increasing jaundice; scanty, high-coloured, biliary urine; and a quick and very feeble pulse. Muttering delirium supervenes; there may be violent vomiting of yellow, biliary mucus; and the patient gradually sinks, and dies after a day or two, or perhaps three or more, of acute disease, and usually within a week of the administration of the poison. Death may occur, however, at any period, from one or two to eight or ten days, after a fatal dose of phosphorus, which may, perhaps, be taken as half a grain for an adult person.

Variations from the above course of symptoms may be noted. In one class of cases the symptoms betoken a predominance of nervous action. Thus there are cramps and pains in the limbs, great prostration and faintness, convulsions, and, finally, coma. In another class, occasionally observed, hæmorrhagic symptoms are prominent, such as bloody vomits and hæmorrhagic diarrhœa. As an early symptom a phosphorescent condition of the vomited matters, and, more rarely, of the urine, may be noted; and in nearly all cases a peculiar garlicky odour of the breath is perceptible. The phosphorescence or luminosity of the rejected matters is of course best seen in the dark. If the phosphorescent condition of the vomit exist, this permits of no mistake in the diagnosis; but if this condition be absent, the garlicky odour of the breath, and an enlarged condition of the liver, greatly aid in the diagnosis.

2. *Chronic Phosphorus Poisoning.*—Chronic phosphorus poisoning consists in poisoning by phosphorus vapours. Workers in common or yellow phosphorus exhibit a singular form of disease from which workers in red or amorphous phosphorus are exempt. This consists in caries of the teeth and necrosis of the lower jaw, conditions which appear to be set up by the direct access of the phosphorus vapours to the parts, since those persons only are affected who suffer from decayed teeth.

Prognosis.—This is in all cases very unfavourable, and no general rules can be laid down as to the issue.

Treatment.—We know but little respecting this matter. Good results appear to be obtained from the administration of an emetic of sulphate of copper, followed by a magma of magnesia, and the use of mucilaginous drinks. The best results, however, have followed the administration of oil of turpentine, which some regard as a specific antidote to phosphorus. It may be given in doses of 10 to 20 minims, frequently repeated.

The chronic form of the disease, which has led to horrible suffering and deformity, may be prevented by the use of red instead of yellow phosphorus in the making of matches. The use of inhalers, and the impregnation of the atmosphere with the vapour of oil of turpentine, are also preventive measures of great service.

Thomas Stevenson.

PHOTOPHOBIA (φῶς, light; and φόβος, fear).—Dread or intolerance of light; a symptom, more or less constant, of most forms of inflammation of the eye. In its most pronounced character it occurs in what is called 'strumous ophthalmia,' or phlyctenular keratitis. It is, however, present in all forms of inflammation and ulceration of the cornea, in iritis and cyclitis, and more rarely in choroiditis and retinitis. It is also often met with in many diseases of the nervous system, in cerebral irritation, meningitis, cerebritis, &c., and in many pyrexial states. As an ophthalmic symptom, it may occur in eyes perfectly blind, and is probably due to the irritation of the ciliary nerves by light. *See* Eye, and its Appendages, Diseases of.

PHOTOPSIA (φῶς, light; and ὄψις, vision).—The subjective sensation of flashes of light, or luminous spectra, due to an abnormal state of some part of the special nervous apparatus of the visual sense. It is a modification of the special sensibility, and, like photophobia, may occur in blind eyes. *See* VISION, Disorders of.

PHRENIC NERVE, Diseases of.—SYNON.: Fr. *Maladies du Nerf Phrénique*; Ger. *Krankheiten des Nerven Phrenicus*.—The phrenic nerve, arising from the third and fourth cervical roots, is the motor nerve for the diaphragm. Morbid states of the nerve, its roots and centre, are manifested by inaction or over-action of the diaphragm, its paralysis and spasm.

1. **Paralysis.**—ÆTIOLOGY.—Paralysis of the phrenic nerve, that is, of the diaphragm, is rarely due to disease of the nerve-trunk. Its common cause is disease at the origin of the phrenic—the anterior grey matter of the spinal cord at the level of the third and fourth cervical nerves. It is often met with as part of acute or chronic spinal muscular atrophy. But the nerve itself has sometimes suffered, with others, in multiple neuritis, such as is produced by lead. In a few cases the paralysis has been apparently due to cold, supposed to have caused a rheumatic neuritis. Rarely, also, the nerve has lost its function in consequence of compression in the neck by deep-seated morbid growths.

ANATOMICAL CHARACTERS.—Degeneration of the trunk of the nerve, wasting of the nerve-fibres, and increase of connective tissue have been found in cases of disease of the spinal cord; and in multiple neuritis acute degenerative changes in the nerve-fibres. Of the anatomical changes due to other causes nothing is positively known.

SYMPTOMS.—The evidence of paralysis of the phrenic is inaction of the diaphragm. When one nerve only is diseased there is imperfect action on one side, and this may be conspicuous or indistinct. When both nerves are affected, as is commonly the case in central disease, there is an entire absence of the normal protrusion of the abdominal wall during inspiration; there may even be a recession of the upper part of the abdomen, from the movement of the lower ribs, and a bulging during expiration in the same situation. In ordinary breathing the respiratory actions are not quickened by paralysis of the diaphragm, but if any exertions are made the respirations become more frequent, and the extraordinary muscles of respiration are thrown into action. All spasmodic respiratory actions—sneezing, coughing—are performed with less energy. Little inconvenience is experienced unless bronchitis comes on, and then the lessened respiratory power may place the patient in a condition of danger, which is especially great, if, as is often the case, the cause of the palsy has also weakened the intercostal muscles.

The phrenic nerve is accessible to direct stimulation in the root of the neck, and when it is paralysed, its irritability is usually lost, and the diaphragm can no longer be made to contract. In rare cases, however, the nerve-trunk retains its irritability.

DIAGNOSIS.—The diagnosis of paralysis of the diaphragm is not always so simple a matter as might be supposed. Its action should be looked for not only in deep breathing, but in ordinary respiration. Many persons, if told to 'take a deep breath,' do not put the diaphragm into action at all. In forced breathing the chief extra action takes place in the upper part of the chest, to which most of the muscles of extraordinary respiration are attached. It is probable that the centres for normal and extraordinary breathing are functionally not identical, and that the diaphragm is chiefly represented in the former, so that it does not necessarily act in deep breathing. There is a mechanical reason for this. In the extreme action of the intercostal muscles the thorax is widened to such a degree that the diaphragm becomes less curved by the movement outwards and elevation of its points of attachment, so that its contraction does not effect much additional enlargement of the capacity of the thorax. Hence, in many persons, without any paralysis of the diaphragm, if a deep inspiration is taken, the epigastrium does not advance; it may even recede, in consequence of this movement of the lower ribs. This is especially the case in women, in whom breathing is always less diaphragmatic than it is in men. In them, too, conscious attention to the act of breathing is apt to arrest the action of the diaphragm. The tendency of voluntary breathing is to be costal rather than diaphragmatic, no doubt because the centre for extraordinary breathing, which is chiefly voluntary, is brought partially into action. In a woman under the writer's care, paralysis of the diaphragm was suspected, and during two separate and prolonged examinations not the slightest action could be observed. On a third examination, however, more normal conditions were obtained, and the action of the diaphragm was natural. This is the condition which has been termed 'hysterical paralysis of the diaphragm.'

It must not be forgotten that immobility of the diaphragm may result from other causes than paralysis of the phrenic nerve. In diaphragmatic pleurisy, for instance, its movement is lessened by a reflex inhibitory effect of the pain. In emphysema of the lungs, in which the thorax is greatly widened, the contraction of the diaphragm produces less effect than in health.

On the other hand, when the diaphragm is really paralysed, a doubt may arise as to

whether it moves or not. This is due to the circumstance that the movement of the lower ribs may drag forward the abdominal parietes close to them, and so the protrusion due to descent of the diaphragm may be simulated. This is especially the case when the abdomen is collapsed, so that when the patient is recumbent its level is considerably below that of the ensiform cartilage. This movement may be distinguished from that due to the descent of the diaphragm by a little care; the movement is confined to the part near the thorax, and there is not the general movement of the abdominal viscera and parietes which results from the contraction of the diaphragm.

Prognosis.—The prognosis of paralysis of the diaphragm is favourable in the rare instances which are due to exposure to cold, and in multiple neuritis, if the patient lives. This nerve, however, is seldom paralysed, except in severe cases of polyneuritis, in which the prognosis is grave; the prospect of recovery is rather less favourable in lead poisoning. It is also unfavourable when the diaphragm suffers as part of progressive spinal muscular atrophy. When there is acute spinal muscular atrophy (anterior polio-myelitis), the prognosis will depend on the indication afforded by other symptoms of the position of the chief disease, as to whether the region from which the phrenic nerve arises is gravely or slightly damaged. When the paralysis arises from compression, the prognosis depends on the nature and cause of the pressure.

Treatment.—The treatment of the paralysis, which is part of spinal amyatrophy, whatever the nature of the morbid process, is that of the central disease. In all cases causal indications must be met. When it is due to cold, sinapisms should be applied over the part of the phrenic nerve which seems, from any attendant pain, to be chiefly affected. If the nerve has not lost its irritability, it may be faradised systematically. The two points to which the rheophores should be applied are (1) in the neck, just above the scaleni, and (2) near the diaphragm. A strong current has to be used.

2. **Spasm.**—Spasm of the diaphragm occurs chiefly in the form of hiccough, and as part of the respiratory spasm in hydrophobia, and does not need further description. *See* Diaphragm, Diseases of; Hiccough; and Hydrophobia.

W. R. Gowers.

PHRENITIS (φρήν, the mind).—An obsolete term, formerly associated with all forms of acute inflammation of the brain or its meninges, but especially the latter.

PHTHIRIASIS (φθείρ, a louse).—Synon.: Pediculosis; Fr. *Phthiriase*; Ger. *Lausesucht.*—This disease of the skin bears the same relation to the pediculus that scabies does to the acarus scabiei.

Description.—There are three varieties of phthiriasis, corresponding to the three species of pediculi that infest the human body. *See* Pediculus.

1. **Phthiriasis capitis.**—Phthiriasis affecting the head is met with chiefly in children. The eruption is an artificial pustular eczema, due to the irritation of the insect, and the scratching of the sufferer. In consequence of the sores on the scalp, the superficial lymphatic glands at the back of the neck often become enlarged.

2. **Phthiriasis corporis.**—Phthiriasis of the body is confined to the parts covered by the clothes, and is most developed on the back. It is especially met with in the old and feeble. The lesions of the skin consist of small excoriations and scattered papules, the tops of which are seen to be torn and bleeding from the scratching of the sufferer. These bleeding papules give to the eruption its characteristic appearance. In chronic cases the general colour of the skin is darkened from an excessive deposit of pigment.

3. **Phthiriasis pubis.**—This variety of phthiriasis differs little from that of the body, except that it is limited to the regions infested by the crab-louse.

All three varieties of the disease are attended with intolerable itching.

Treatment.—Phthiriasis is easily cured by means of an ointment containing one part of the oil of stavesacre and seven parts of lard; or the white precipitate ointment may be safely used for phthiriasis capitis or phthiriasis pubis.

Robert Liveing.

PHTHIRIUM INGUINALE (φθείρ, a louse).—One of the synonyms of *pediculus pubis*, the crab-louse. *See* Pediculus.

PHTHISIS (φθίνομαι, I waste).—Synon.: Consumption; Fr. *Phthisie*; Ger. *Lungenschwindsucht.*

Definition.—Phthisis, or consumption, is the term used to designate a disease characterised by progressive wasting of the body; persistent cough, with expectoration of opaque matter and sometimes of blood; loss of colour and strength; shortness of breath; hectic fever, night sweats, and diarrhœa; these symptoms being associated with certain well-marked pathological changes in the lungs, namely, the formation of consolidations in a granular or diffuse form, associated with the presence and irritating influence of an organism, the *bacillus tuberculosis*; these undergoing either caseation or disintegration, leaving behind excavations in the lung-tissue, or, becoming indurated and shrinking, causing contraction of the affected organ.

Ætiology and Pathology.—Owing to the discovery by Koch of a specific organism, the bacillus tuberculosis, in the lesions of tubercle, phthisis must be counted among the diseases of germ origin. Whilst without

the bacillus the disease cannot exist, a predisposing cause, to fit the individual's organs for the reception of the organism, appears as necessary for the production of phthisis as the bacillus itself. Such predisposing causes, to be alluded to presently, are family predisposition, impure atmospheres, unhealthy occupations, and the like, which weaken the system of the individual and lower his power of resistance. The tubercle bacillus is a rod-like organism, varying in length from $\frac{1}{8000}$ to $\frac{1}{12000}$ inch, and having a breadth one-fifth of its length, or from a quarter to half the diameter of a red blood-corpuscle. It has an external membrane capable of absorbing fuchsin but not methylene blue, hence the differences in the apparent thickness of the specimens stained by various methods. The tubercle bacillus multiplies by spores, each rod dividing into several smaller rods, and each division containing spores, the rate of multiplication being very rapid. The tubercle bacillus has been detected in the sputum of consumptives not only with cavities, but with tubercular consolidations, though in this case in smaller numbers; and it has been sought for in vain in the sputum of other lung-diseases. It has been seen in the blood of phthisical hæmoptysis (by Perez and the writer), in the fæces from tubercular intestines (Gaffky and Taylor), in the urine from scrofulous kidneys (strumous pyelitis), and in the air exhaled by consumptives (by Ransome and the writer). Tubercle bacilli have been found in the various lesions of pulmonary tuberculosis, of tubercular meningitis, of tuberculous ulcer of the tongue; in tuberculous kidney, spleen, suprarenal capsule and testicle; in scrofulous glands of the neck, axilla, and groin; and, in larger abundance, in bronchial and mesenteric glands; in the various strumous lesions of the bones and joints; and finally in sections of the skin in lupus. Tubercle bacilli abound in *Perlsucht* or bovine tuberculosis, in the tubercle of the horse, and in all tubercular lesions of animals inoculated with tubercle. The milk, too, of tuberculous cows has been shown to contain them, though only where the udders have been the seat of the disease. The part played by the bacillus in the causation of tuberculosis is well illustrated by the changes in the eye of a rabbit after inoculation of the anterior chamber with tubercle, as practised by Baumgarten. The first change is the formation of a scar, and the encapsulation by granulation-tissue of any foreign body that has entered. After the second day the enclosed bacilli increase in numbers, penetrate the granulation-tissue, and press in masses into the iris and sclerotic. On the sixth day there are found, in connexion with tubercle bacilli in the cornea and iris, some few cells of an epithelioid kind, giant-cells, and lymphoid cells characteristic of miliary tubercle. On the tenth and eleventh days the changes become macroscopic, and indicate breaking down and disorganisation of the whole tissue.

Veragut's experiments on rabbits made to inhale a spray containing tubercle bacilli show that after fourteen days' inhalation bacilli were detected in the alveolar cells, and that their entry had been accompanied by hyperæmia of the capillaries, and exudation of lymphoid cells into the infected alveoli.

The tubercle bacillus being thus shown to be a cause of tuberculosis, we will now consider what agencies predispose the human body to its successful invasion; and these may be divided into (1) *general predisposing causes*, which act by weakening the constitution and rendering it more liable to bacillar attack; and (2) *local predisposing causes*, which act by interfering with the free play of the thorax and lungs during inspiration, such as tight lacing, dry pleurisy and pleuritic adhesions, old pulmonary lesions, &c.

The most important predisposing causes of phthisis will now be individually discussed.

1. Family predisposition.—The influence of heredity as a cause of phthisis cannot be doubted; it has been abundantly proved by observation and experiment on both man and the lower animals. The term *family* predisposition is substituted for *hereditary* predisposition, because the latter, from its limitation to direct descent, necessitates the omission of the evidence of disease in collateral relatives. The statistics of the first *Report of The Brompton Hospital for Consumption and Diseases of the Chest* on this point, as compiled by Sir Richard Quain, who contrasted them at the same time with the statistics of insanity, and those also of Drs. Cotton and Fuller, show that among the lower classes hereditary predisposition (that is, where one or both parents were affected) was traced in 25 per cent. The writer's researches among 1,000 cases of the upper classes show 12 per cent. of direct hereditary predisposition, and 48 per cent. of family predisposition.

Family predisposition is more common among women than men, in the proportion of 57 to 43, which may be accounted for by the more sedentary and less invigorating life of the former. The transmission of phthisis is more common through the mother than through the father; but where one parent alone is affected, fathers transmit more readily to sons, and mothers to daughters, than the converse. Dr. James Pollock lays stress on the influence of hereditary predisposition in the acute forms of phthisis, and states that out of 179 acute cases only 34 could positively declare absence of family taint. Dr. Reginald Thompson shows that double heredity, that is, both parents being affected with consumption, exercises a more unfavourable influence than single heredity, and specially among males, the result being a larger proportion of acute and fatal cases,

and a greater tendency to hæmorrhage. Comparing the relative influence of father and mother on the children, the maternal heredity is worse for both sexes, as the paternal inheritance generally includes some of the resisting power to the disease which characterises the stronger sex. The principal effect, however, of family predisposition is to be seen, *not* in any peculiarity of symptoms, but by the influence it exercises over the age of attack. The writer's researches show clearly that this is much earlier in patients so predisposed than in others ; and in females this influence is greater than in males.

2. **Acute febrile diseases.**—Continued fevers, measles, and scarlet fever act partly by exhausting the system, and partly by bequeathing to the individual the legacy of vulnerable areas either in the lungs or glands, which prove the centres of subsequent tuberculisation.

3. **Syphilis.**—Syphilis, by its debilitating influence, predisposes to phthisis ; but it also appears to act as a cause capable of developing two forms of the disease, namely (1) limited consolidation with no great tendency to excavation; and (2) a form of laryngeal phthisis, characterised by ulcers in the larynx and in the pharynx, difficult to heal except by specific treatment. This last has been called syphilitic disease of the larynx ; but, as in the writer's experience it is always associated with tubercle in the lungs, he thinks that the phthisis is caused by the syphilis, and should be classed accordingly.

4. **Debilitating conditions.**—Miscarriages, unfavourable confinements, over-lactation, insufficient food, and alcoholism are recognised causes. The cessation of habitual discharges is not so clearly to be admitted as a cause; but the stoppage of the discharge of a fistula in ano, or the drying up of an old ulcer, is frequently followed by the development of tuberculosis in the lungs.

5. **Mental depression.**—This is often mixed up with other causes, but occasionally acts alone.

6. **Bad ventilation.**—Dr. Guy has shown that consumption is more rife among persons of indoor occupations than among those employed out of doors. This is true not only of the working classes, as printers, compositors, and tailors, but also of the tradesmen who live in hot gas-lit shops, and often sleep in miserably ventilated bedrooms. These are not ill-fed, but are nevertheless twice as liable to consumption as the upper classes. Hawkers and other outdoor trades, though much exposed to catarrh, are shown to be less liable to consumption than indoor workers. Of nearly 6,000 cases of phthisis admitted into the Brompton Hospital during ten years, two-thirds followed indoor occupations. Amongst them milliners, sempstresses, and tailors, who work and possibly live in close rooms, to which they are almost entirely confined, furnish the largest quota.

7. **Climatic influences.**—A moist atmosphere is more favourable to the development of consumption than a dry one ; and, while we recognise that the combination of cold and moisture is one of the principal predisposing causes of the disease in Great Britain, the testimony of Dr. Guilbert indicates that a combination of heat and moisture, as exemplified in the littoral of Peru, in the West Indies, and in other hot and moist localities, produces an acute form of consumption, largely prevalent in those districts, which attacks the abdominal organs in addition to the lungs.

8. **Dampness of soil.**—The researches of Sir George Buchanan have demonstrated that the death-rates from phthisis in the districts of Surrey, Kent, and Sussex, depend to a great extent on the geological formation of the soil ; for while in the light and sandy strata deaths from phthisis are rare, in the heavy impermeable ones, in which clay predominates, the mortality from this cause is high. The conclusion that wetness of soil is a cause of phthisis to those living on it has been confirmed by the Registrar-General of Scotland, and by Dr. Bowditch of the United States ; the latter testifying that this law holds good, not only as regards villages and towns, but even as regards individual houses—the houses on clay becoming the foci of consumption, while others but slightly removed from them, but on a dry soil, escape.

9. **Inoculation.** — From the time of Laennec until the present, experiments have been carried on by numerous observers to ascertain whether tubercle is, or is not, inoculable ; and the results of the experiments of Villemin, Simon, Marcet, Sir Andrew Clark, and Lebert proved that in guinea-pigs and rabbits tubercle could be produced artificially by the insertion underneath the skin of tubercular material. In 1874 Demet and Zablonus of Syra inoculated a man of fifty-five suffering from gangrene with tuberculosis, by inserting phthisical sputum under the skin of the right leg. Three weeks after the inoculation signs of commencing induration of the right apex were detected, both lungs being previously healthy, and seventeen days later the patient died of gangrene. After death the right lung showed freshly formed tubercle of both apices, thus proving the possibility of inoculating man with tubercle. The experiments of Burdon Sanderson, Wilson Fox, Cohnheim, Fraenkel, and Schottelius, who apparently produced tuberculosis in animals by injecting non-tuberculous material, threw doubts on the specificity of tubercle ; but the test observations made by Cohnheim, Fraenkel, and Dawson Williams showed the human experiments to have been made in atmospheres tainted with the

tubercular virus, and that when these sources of error were removed the inoculation of non-tuberculous material gave negative results. Koch inoculated with a fluid obtained from his culture-experiments on tubercle no less than two hundred rabbits and guinea-pigs, the points of insertion being the skin, the peritoneal cavity, and the anterior chamber of the eye. With one exception, all these animals acquired tuberculosis of the lungs, liver, spleen, and other organs; and the tubercles had the characteristic structure, with giant-cells, and contained tubercle bacilli.

Koch found that the results of the inoculation depended largely on the strength of the bacillar solution. If the fluid was weak, miliary tuberculosis resulted; if it was strong, then tubercular infiltration and rapid caseation occurred. Moreover, of all the methods of inoculation, that into the veins was the most effectual; but other channels, including the anterior chamber of the eye, were found to answer. Experiments on dogs, rats, goats, and hens were successful, though not so successful as those on rabbits and guinea-pigs.

Chauveau found that heifers might be infected by mixing tuberculous matter from their own species with their food. Bollinger confirmed this experiment, but found that carnivora could be fed with impunity on fresh tuberculous matter taken from animals of the bovine species.

10. **Infection.**—The idea of infection being a cause of phthisis largely prevails in the South of Europe, and was revived in England by the late Dr. William Budd. The evidence of the Brompton and Victoria Park Hospitals negatives the idea of a contagion such as is present in small-pox or scarlet fever; for it has been demonstrated that the percentage of acquired phthisis occurring among the resident staff of these institutions is less than that of most general hospitals; and even when any defective ventilation or overcrowding has given rise to evil consequences, these have shown themselves in outbreaks of erysipelas and sore-throat, and not in tuberculosis. Nevertheless phthisis has been shown to have been communicated by inhalation on some very rare occasions under the following circumstances: (1) close intimacy with a consumptive patient in advanced disease, such as sleeping in the same bed or room; (2) activity of the tubercular process, either in the way of tuberculosis or excavation; (3) neglect of proper ventilation of the room occupied.

That phthisis may be communicated from husband to wife is strongly maintained by Virchow and many English physicians, and Dr. Hermann Weber has indicated by some striking cases the danger of pregnancy to the wife of a consumptive.

Infection is possible through the milk of a tuberculous cow, provided the udder be affected; and the consumption of the meat of tuberculous animals has been proved to give rise to phthisis. Dogs have also become tuberculous from licking up the sputum of phthisical patients; and inoculation of a servant girl in the hand from the fragments of a spittoon containing the same material has been reported.

11. **Local predisposing causes.**—The local predisposing causes of phthisis are those which injuriously affect the bronchi and air-passages, causing large epithelial proliferation and various inflammatory lesions, which form a favourable nidus for the bacillus, followed by thickening and induration of the alveolar walls, and in time end in caseation or fibrosis.

Bronchitis, or bronchial catarrh, after existing in a person for many years, may extend more deeply into the alveoli and pass into a so-called catarrhal pneumonia, and produce consolidation. Bronchitis was the origin in nearly 12 per cent. of the writer's 1,000 cases; and a very large number of the poorer classes trace their disease to neglected catarrh.

Pneumonia is a fruitful source of phthisis, though some forms are more capable of giving rise to it than others. In croupous pneumonia, where the exudation is fibrinous, and has but little epithelium or leucocytes intermingled with it, absorption generally follows, if the patient's constitution be in a fair state, and few of these cases go into phthisis; but where leucocytes and epithelial products largely predominate, absorption is slow, the pneumonia becomes chronic, and thickening of the alveolar wall and degeneration of the epithelium take place, accompanied sooner or later by the signs and symptoms of consumption. A third form of pneumonia which may originate consumption is pleuro-pneumonia, or interstitial pneumonia where the inflammation extends to the pleura, and the interlobular connective tissue is largely increased. Many instances, too, of phthisis have arisen in empyema, through absorption of the purulent fluid, the channels being the elaborate network of lymphatics which Dr. Klein and others have shown the pulmonary pleura to contain.

12. **Trades and occupations giving rise to a dusty or gritty atmosphere.**—The constant inhalation of particles of flint, iron, coal, hard clay, and even of cotton, flax, and straw, as is the case in certain occupations, such as stonemasons, fork- and needle-grinders, colliers, potters, cotton-carders, chaff-cutters, and others, has been shown by the late Dr. Greenhow to induce phthisis. The various irritating particles have been detected microscopically and chemically in the lungs, where they appear to cause great irritation, followed by thickening of the bronchi and subsequent induration of the lung-tissue, with increase of pigment. Intermingled in the consolidations

are found caseous masses and also extensive cavities, in both of which tubercle bacilli have been detected in large numbers, proving the identity of the disease with phthisis.

13. **Injuries to the lungs.**—Injuries to the lungs through wounds are somewhat rare predisposing causes of phthisis. They chiefly act by inducing the inflammatory processes, chronic suppuration and abscess, or induration with shrinking of the lung-tissue.

Anatomical Characters.—The morbid anatomy of phthisis, acute and chronic, presents considerable difficulties, partly from the variety of pathological products, and partly from the complete disorganisation of the normal structure, and even of the invading growths. It often happens that several processes have been going on in the lungs simultaneously, each of which brings about the work of destruction by a different method and at a different rate, some by obstruction through consolidation, others by caseation and excavation. On the predominance of one or other of these depends the future of the lungs, for we sometimes see one pathological element which has invaded a large portion of these organs superseded and gradually destroyed by another of more recent date, but endowed with a higher degree of vitality.

In advanced cases the lungs are for the most part devoid of vesicular tissue, and consolidated by various kinds of growths and exudations. They are also occupied by cavities, varying in size from a microscopic point to one of so large a capacity that the lung is converted into a mere bag of thickened pleura. The cavities are of every conceivable form and shape, sometimes oval and well-defined, lined with a secreting membrane, at other times irregular, sinuous, anfractuous, and presenting on section either an uneven surface, from which portions of the wall stand out like the columnæ carneæ of the heart, or a very rugged surface, on which ulceration and suppuration appear to have done their worst; but, whatever be their shape or their size, they indicate the destructive character of the retrograde processes by which the disease called pulmonary consumption is characterised.

The consolidations vary, but all partake more or less of a tubercular character. In some cases the lungs are studded with miliary tubercles from apex to base, the intervening tissue being free from excavation, and either engorged or consolidated with red hepatisation, or sometimes apparently healthy; in other cases no trace of miliary tubercle can be found, but the lungs are consolidated throughout by caseous pneumonia, containing cavities of various sizes. Sometimes there are aggregations of the different forms of tubercles—white, grey, and yellow in the same lung—while the opposite lung may be entirely clear; sometimes a lung may be shrunk to the size of a closed hand, its pleura thickened, its lobules invaded with white fibrous bands, its tissue converted into an iron-grey structure by fibroid growth. All these, and many other diverse morbid appearances, are found in the lungs of persons dying of phthisis, and we must classify and distinguish them, first describing their naked-eye appearances; secondly, their histological phenomena; thirdly, we must consider the changes which take place in other organs of the body; and, fourthly, we must indicate the pathological relation these all bear to one another and to the disease generally.

The principal pathological elements and changes in the lungs are: (1) Grey and dark granulations, or miliary tubercles; (2) white granulations; (3) yellow granulations, or yellow tubercle; (4) caseous masses, or yellow infiltration; (5) grey infiltration, or catarrhal pneumonia; (6) red hepatisation; (7) fibrosis; (8) cretaceous masses; (9) fibrinous nodules (blood-residues); and (10) vesicular emphysema.

1. **Grey granulations, or miliary tubercles.**—These vary in size from a millet-seed (hence the name miliary) to a hemp-seed, scattered throughout the lung-tissue. When first formed they are greyish-white, more or less transparent, and will yield to firm pressure; but after a while they either undergo caseation, being converted into the yellow variety, or, losing moisture, become drier and harder, attaining the consistency of cartilage. At the same time pigment is absorbed by them; the colour passes from a light to a dark grey, or even to black; the granulations simultaneously drying up and becoming obsolescent. These hard grey granulations are not uncommonly found after death in old persons, and are an evidence of tubercle having appeared at some period of their lives, and of its having afterwards become obsolescent.

More commonly these grey granulations increase in number, and form aggregations or clusters, much resembling bunches of berries, standing out in bold relief against the healthy or congested lung-tissue; their principal locality being the upper lobes of the lungs, and especially the posterior portions. In some instances this aggregation spreads quickly and extensively, and the whole lungs become so densely packed with miliary tubercle that it is difficult to find any portion of the respiratory surface free. This rapid formation of tubercle is sometimes sufficient to cause death by asphyxia, but more commonly the intense crowding of the pathological products gives rise to their destruction. Caseation commences in the centre of the groups, and cavities subsequently form. The discrete form of grey tubercle is generally found in acute miliary tuberculosis, and does

not vary much in size with the different organs or structures attacked by tubercle.

2. **White granulations.**—These formations are more opaque and softer than the grey, and differ from the latter, as we shall hereafter see, in the arrangement of the histological elements, there being more epithelium and less reticular growth in them than in the grey variety.

3. **Yellow granulations.** — Yellow granulations or yellow tubercles exist in varying sizes, from a pin's head to a pea. They are opaque, soft, granular, amorphous, easily separated from the adjoining tissue, and sometimes surrounded by a circle of pearly transparent material. The late Dr. Wilson Fox described a form of yellow tubercle in children dying of acute tuberculosis, which is with difficulty separated from the parenchyma of the lungs; but in adults it is generally easily removed, the grey granulations with which it is so often associated remaining behind.

Yellow granulation is by far the commonest form of tubercle, and its frequent occurrence in phthisis led Laennec not unnaturally to the conclusion that it was a *sui generis* production, essential to the disease. It seldom occurs alone, but is ordinarily associated with the grey and white granulations, sometimes forming with them racemose groups in various parts of the lung, chiefly in the upper lobes. At other times it is the centre of an affected portion, groups of grey granulations apparently radiating from it, thus naturally leading to the supposition that a species of local infection has been set up by the yellow or caseous mass. These groups, as they increase, exercise great pressure on the various granulations composing them and on the intervening lung-tissue, depriving them of nutrition, and thus causing death of the part by caseation. The decayed portion is gradually removed either by absorption by the lymphatics, or by expectoration; in the latter case cavities result. Careful study of one of these tubercular groups will demonstrate that the yellow tubercle is but a later condition of the grey, in which caseation has commenced; and that the cavities, large or small, in its neighbourhood are the result of the softening and removal of the yellow tubercle, and whatever lung-tissue happens to be intermingled with it. The caseation of miliary tubercle has generally been attributed to retrograde changes arising from deficient blood-supply, no blood-vessels having been discovered in miliary tubercle; but Mr. Watson Cheyne holds that it is caused by a chemical change in the epithelioid elements of which tubercle is composed, induced by the action of the tubercle bacilli which are found to swarm in fresh caseating centres.

4. **Caseous masses.**—Caseous masses and yellow infiltration are identical in constitution with the yellow tubercle, but differ in size and form, arising sometimes from the aggregation of a number of yellow granulations, but oftener from the rapid caseation of inflammatory exudations, the caseation being due in this case partly to obliteration of nutrient vessels from pressure, but chiefly to the action of the tubercle bacillus. Whole lobes become affected with what is then called yellow infiltration.

5. **Grey infiltration: catarrhal pneumonia.**—This change is identical with the 'gelatinous infiltration' of Laennec. The pressure on the walls of the alveoli caused by the epithelial aggregations, as well as by the inflammatory exudation, gives rise to obliteration of the vessels and consequent caseation, and in this way large tracts of grey pneumonia are converted into yellow masses, and subsequently become excavations. It is probable that here the caseous conversion is also due to bacillary action, but in the caseous masses themselves Dr. Percy Kidd and others have found but few, if any, tubercle bacilli. When liquefaction of the mass occurs, ending in excavation, the bacilli swarm, whence Koch infers that spores must have existed in the dry caseous tracts. Cavities formed in this way are large, and present ragged and granular interiors.

6. **Red hepatisation.**—The result of ordinary croupous pneumonia is often found associated with one of the above forms of tubercle, but more commonly occurring in the lower lobes than in the upper. *See* LUNGS, Inflammation of.

7. **Fibrosis.**—Fibrosis is largely present in phthisis, but preponderates (1) in cases originating in pleuro-pneumonia, pleurisy or pneumonia; and (2) in cases of long duration. Fibrosis is the great element of the contractile process, whereby the lungs are reduced considerably in size, cavities of large capacity are cicatrised, and caseous masses encapsulated; and sometimes grey tubercle is converted into this tissue.

A lung invaded by fibrosis is reduced in size, and presents on section a dense, tough, and very hard structure, resembling cartilage in its resistance to the knife. All traces of the alveoli have disappeared, and nothing remains but a dark grey or black fibrous material, into which run long bands of whitish fibrous tissue, harder than the darker portions. The pleura is generally thickened, and the septa apparently arise from it and from the connective tissue at the root of the lung, which is also largely increased. Fibrosis is found in limited portions of the lung, in nearly all kinds of phthisis, forming the scars of contracted cavities, or tending to isolate caseous masses and tubercular aggregations. When miliary tubercle becomes converted into fibroid growth, the resulting tissue is of short duration, owing to its deficiency of blood and lymph vessels; caseation

consequently takes place at various points, and it thus perishes. Tubercle bacilli are never found in fibroid tissue, which must be regarded as a secondary product, not a primary one.

8. **Cretaceous masses.**—Cretaceous or chalky material is found in chronic cases, lying in small masses in various parts of the lungs, chiefly at the apices, in the neighbourhood of old cavities or caseous tracts, and generally encapsulated by fibroid tissue. Cretaceous material is most common in tubercular bronchial glands, which by their enlargement and pressure on the bronchial tubes cause ulceration of these last, and discharge their contents through the openings. Much of the calcareous matter which consumptives expectorate is derived from this source.

9. **Fibrinous nodules.**—These bodies have been noticed by Dr. Reginald Thompson in cases where large hæmoptysis has occurred. They vary greatly in size; consist of inhaled blood; and are situated at portions of the lung where inspiratory action is strongest. When first found, they appear as white nodules with a zone of red colouring matter; and even in the old specimens some traces of blood in the form of crystals of hæmatin are to be found. Microscopically they are shown to consist of fibrin and red corpuscles, filling the alveoli and even penetrating the alveolar wall. The masses eventually either (1) separate from the surrounding tissue through contraction of the fibrin, leaving a capsule adherent; or (2) owing to admixture with bronchial secretion or some such septic matter, they soften into a mortar-like material, and are got rid of by expectoration; or (3) if the nodule be sufficiently large, and there be no exit for its contents, the result is the formation in time of a species of cavity filled with glairy yellow fluid, resembling honey.

10. **Vesicular emphysema.**—Two kinds are noted in the lungs of phthisical patients. *Acute vesicular emphysema* is found distributed throughout the lungs of those dying of acute tuberculosis; and *chronic local emphysema* occurs in connexion with chronic tubercular masses, and specially in the neighbourhood of cicatrised cavities. The vesicles are few in number, and often as large as a hazel-nut, and are generally to be found at the apex, or along the anterior border of the lung.

Microscopical Characters.—In cases of tuberculosis and phthisis, the following histological elements (as classified by Dr. Green) are present in the lungs, in addition to the tubercle bacillus, which probably by setting up irritation in the tissues is the cause of their production. The amount of importance to be attached to each element has not yet been determined.

1. *Exudation.*—Exudation of fibrin and leucocytes into the alveoli, resembling that of croupous pneumonia, the fibrillation not being quite so distinct, nor the coagulum so abundant. In a large number of cases of phthisis, the lung-consolidation consists of exudatory products mingled with epithelial proliferation; and in some of the most acute instances these two processes have constituted the only lesion.

2. *Epithelial accumulations.* — Three forms of cell are generally present—(1) The ordinary epithelial cell lining the alveolus; (2) epithelioid cells. These are generally large spheroidal cells about four or five times the size of a leucocyte, containing granular matter, and a nucleus and nucleolus. They are derived (Watson Cheyne) from the epithelium, and are occasionally transformed later into giant-cells, or more commonly undergo caseation. Some smaller ones are also observed, indistinguishable from leucocytes. Within the alveoli also are found the (3) 'giant-cells,' held by Klein and Green to be derived from the alveolar epithelium by fission or excessive development, a view confirmed by Watson Cheyne, who has watched the actual stages of production, and has noted the presence of carbon particles in the interior of the epithelioid cells. The cells appear at first as spheroidal masses of faintly granular protoplasm, reaching $\frac{1}{200}$ inch in diameter, with numerous nuclei—sometimes as many as thirty, and bright nucleoli. After a while they increase in size, and send out branched processes, from which are developed other smaller protoplasmic masses, so that a branched reticulum is formed round the original giant-cell, connecting it with other giant-cells. These branches are often directly continuous with the lymphoid or adenoid network of the alveolar wall, to be presently alluded to, which forms a circle round the giant-cell system, and is in time converted into fibrous tissue. Giant-cells are not always found in the earlier stage of tubercle development, and are more plentiful in tubercle of slow than of rapid growth. They are devoid of any vascular supply, and are consequently subject to caseation, having in such cases previously undergone a peculiar transformation into a fibroid material. Giant-cells are regarded by Dr. Green as a product of low vitality, incapable of forming organised tissue; where the protoplasm grows, the nuclei multiply, but the highest manifestation of cell-life—division of the cell—does not take place.

3. *Intralveolar growth.*—This is a thickening of the alveolar wall by a small-celled lymphoid tissue, consisting of minute cells not larger than a leucocyte, separated from each other by a very delicate reticulum. This growth appears to commence in the walls of the alveoli and terminal bronchi, first in the form of a few lymphoid cells, the

network appearing later, and has been stated by Sanderson to be a hyperplasia of the adenoid tissue already existing in the lungs; for it must be borne in mind that lymphatics and lymphoid tissue are largely present in these organs, and that the alveolar wall is considered one of the densest lymphatic plexuses of the whole body. The existence of the delicate reticulum is denied by Cornil and Ranvier, and by Watson Cheyne, the latter ascribing the appearances to infiltration of the fibrous tissue around with leucocytes.

The small-celled tissue spreads rapidly through the alveoli, invading the walls of the capillaries, the peribronchial and perivascular sheaths, diminishing by pressure the calibre of the vessels, and in time obliterating them, and thus giving rise to necrobiosis by caseation and ulceration of the surrounding tissues. The growth fills up the alveoli, and thus infiltrates whole tracts of the lung, which in time become cut off from both air and blood supply. This either degenerates by caseation, giving rise to the formation of cavities; or the cells become more spindle-shaped and branched; the reticulum more fibrillated; and then gradual fibrosis of the nuclear tissue takes place. Owing, however, to the disappearance and obliteration of the vessels, this tissue is not properly supplied with nourishment, and soon undergoes caseation.

4. *Interlobular growth.*—Increase in the interlobular connective tissue resembles the process prevailing in the liver, kidneys, and other organs during chronic disease, and is not necessarily associated with consumption. This feature is most marked in cases cf inflammatory origin, or where the disease is of very loug standing; and the result is best seen in the large fibrous septa often accompanying the bronchi and great blood-vessels, as is specially exemplified in fibroid phthisis. Microscopically it is difficult to distinguish between the interlobular tissue and the alveolar adenoid growth in their early stages, both being richly cellular; the main differences being the situation of the former around the lobules, and in the neighbourhood of the great air and blood vessels, whereas the latter is found in the alveolar wall and smaller bronchioles. The interlobular tissue is not so liable to retrogrado changos, owing to tho vascular supply being less liable to obstruction and obliteration; and, again, the alveolar growth has, where present, a more delicato reticulum of fibres.

Changes in the bronchi, pleuræ, and bronchial glands.—The *bronchi* show, in many cases, catarrh of the mucous membrane, giving rise to a richly cellular secretion, which forms the greator proportion of tho expectoration of phthisis, as the principal lesion, and extending in acute cases throughout tho whole bronchial tree. In moro chronic forms the catarrh is limited to the bronchi loading to the affected lobules. A second and moro important change is the infiltration, notod by Rindfloisch, of the sub-epithelial connective tissue by large cells characteristic of scrofulous inflammation, and very difficult of absorption. The mucous membrane appears swollen and opaque; the epithelium may be shed; and should the sub-epithelial infiltration disintegrate, small ulcers are formed. A third change is the infiltration of the peribronchial tissue, and the proliferation of lymph-follicles in the walls of the smaller bronchi, owing to transmission of infective substances, including bacilli, from the bronchi through the lymphatics. The bronchi from these changes become reduced in calibre, and consequently the adjoining ones, as noticed by Grancher, are often dilated through the action of increased air-pressure on their walls. Rindfleisch holds that the earliest lesion of phthisis is a tubercular infiltration of the angles and projections of the terminal bronchi at their junction with the alveoli.

In laryngeal phthisis ulceration is to be found in the bronchi, as in the larynx. *See* LARYNX, Diseases of.

The *pleura* is often adherent over the region of tuberculisation when the formation has taken place slowly, and is comparatively superficial. It is often considerably thickened, as in fibroid phthisis, to the extent of three-quarters or one inch in depth, the layers being sometimes separated, as Dr. Douglas Powell has shown, by a gelatinous material, consisting chiefly of connective tissue.

The pleura, peritoneum, arachnoid, and even the pericardium, may be the seats of miliary tubercle in the most acute form of phthisis, namely, miliary tuberculosis; but it is generally noted that the lungs are the first organs attacked, and it is extremely rare for tubercle to exist in any organ without being also present in the lungs.

The bronchial, cervical, mesenteric, and other *glands* undergo various changes. In many and especially in advauced cases, the bronchial glands enlarge and become deeply pigmentod; in other cases they seem to partake of the changes proceeding in the lungs: they become affected with grey tubercle and caseato, and occasionally cretify, the cretaceous material being, as a rule, in the contre of the gland, though the roverse is occasionally tho case, and the calcareous matter forms a shell over the whole gland (*sec* BRONCHIAL GLANDS, Diseases of). They oxorcise pressure on the trachea sufficient in infants occasionally to produco suffocation or to erode tho wall, and then discharge their coutents through the opening. The other lymphatic glands, ospecially the mosenterie, are liablo to similar changes.

Other organs.—Tho stomach and intestines in protracted casos becomo greatly

attenuated, all the coats being thinned and wasted; and in many cases they are found to have undergone lardaceous degeneration, which is a common cause of diarrhœa in phthisis. Where the diarrhœa has been very persistent, it is common to find extensive ulceration of the jejunum, ileum, cæcum, and large intestine, extending even to the sigmoid flexure and rectum; the cæcum being earliest attacked, and generally in a more advanced stage than the small intestine. Ulceration was noted in 71 per cent. of patients dying of phthisis at the Hospital for Consumption and Diseases of the Chest, Brompton. The ulcers vary much in form and extent: in some instances they are circular, clearly cut depressions; in others, and this is the commoner form, they present large, raised, irregular edges, with fæces adherent to their ragged surfaces, and they can be often seen through the attenuated external wall of the intestine. Tubercle bacilli have been detected in the intestinal ulcer and also in the ochrey stools. The peritoneal coat, as a rule, is thickened in their neighbourhood, and thus perforation of the intestine is prevented. The earlier stages of this process appear to be: Miliary tubercles form in the submucous coat, not only in the solitary glands and Peyer's patches, but scattered throughout the submucous layer, appearing as granules shining through the epithelium; yellow points of caseation become visible in some parts, and small abscesses form in others, the latter appearing to have their seat in the solitary and agminated glands; and, later on, these discharge, leaving ulcers of different forms. Ulceration of the large intestine penetrates very deeply, and often resembles that of old dysentery. Perforation rarely occurs, on account of the thickening of the peritoneal coat taking place outside the ulcers, but occasionally it does happen, causing fatal peritonitis.

The liver is rarely normal, but generally undergoes either fatty or lardaceous degeneration. The spleen is softened, and very commonly lardaceous. The kidneys are not generally affected, but where albuminuria has prevailed towards the close of the disease, fatty or lardaceous or granular changes occur. The heart is usually small, and the muscular tissue pale, and very often in a state of fatty degeneration (Quain). Fatty growths may be found on the surface.

Pathology.—The nature of tubercle has long been a subject of discussion. In the sixteenth century two forms of tubercle (scirrhous and caseous) were recognised, showing that even at this period a distinction had been drawn between grey and yellow tubercle. Later on, the similarity of the changes occurring in the tubercular masses to the softening of scrofulous glands, led Portal to conclude that tubercles were engorged lymphatic glands situated at various parts of the lungs, the engorgement terminating in suppuration. Laennec applied the term 'tubercle' to miliary and yellow granulations, as well as to grey and yellow infiltration, but considered that it was a *sui generis* production, unconnected with inflammation. Broussais, Andral, and Cruveilhier assigned an inflammatory origin to tubercle, the latter considering that tubercle is the result of chronic inflammation of the lymphatics of the lungs. At length Virchow restricted the term 'tubercle' to the grey granulation, which, according to him, originates in the connective tissue, and is of a cellular nature. Rokitansky, Dr. C. J. B. Williams, and others considered that tubercle was principally an exudation from the blood-vessels, the different varieties depending on the kind of exudation, and on the part played by the leucocytes. Drs. Sanderson and Wilson Fox held that the grey tubercle consisted of the small-celled adenoid tissue with such epithelial accumulations as may be imprisoned in the course of its growth; but the latter subsequently adopted Koch's discovery of the bacillus and the conclusions it necessitated. This discovery has undoubtedly revolutionised our views of the pathology of phthisis, for we must now regard the chief histological elements, enumerated above, not as essential factors, but as results of the irritation to the tissues caused by the presence of the bacillus, their number and variety depending on the rapidity of the onset, and the time permitted for reaction on the part of the tissues. For example, the first effect of the entry of the tubercle bacillus into the alveolus would be epithelial proliferation, and possibly, from penetration of the capillaries, exudation of fibrin, and leucocytes. Then if the bacilli are very numerous, or the irritation they set up be very considerable, the alveoli may be stuffed with exudation and epithelial proliferations, which would rapidly caseate. If, however, the irritation be less, the process is slower, and giant-cells are evolved, which, according to some authorities, are an attempt of the organ at self-protection (*see* Phagocytosis). These may in turn perish under the attack of the invader, or be converted into fibroid tissue, and thus resist further advance by encapsulation. The interalveolar lymphoid growth may be the result of bacillar irritation in the alveolar wall; but, being devoid of blood-vessels, it soon undergoes caseation through the action of the bacilli. The fourth histological element, the growth of the interlobular tissue, though it may be due to bacillar irritation, has a distinctly limiting influence on the advance of the organism, and no bacilli have hitherto been found in this tissue. Tubercle bacilli are found invariably in freshly formed tubercle, but in grey or miliary of some date they are often absent, owing to the tubercle having undergone fibrosis. They are present in white and yellow granulations, and in

recently formed caseous masses, but not in the other pathological elements, which, though associated with tubercle, are mainly of inflammatory origin.

The process of softening is due partly to overcrowding of the corpuscular products and partly to a chemical process, arising, according to Watson Cheyne, from bacillar action.

When cavities have formed, bacilli swarm on their walls and in their contents, and the more rapidly they are formed the larger the number of bacilli present.

It is obvious that, whatever part the bacillus plays in the causation of phthisis, the condition of the individual attacked, and his constitutional powers of resistance, are quite as important, as on these depend the whole question of vulnerability. It is probable that in most cases of consumption the bacilli reach the lungs through inhalation; but why, out of a number of persons placed under similar conditions, apparently necessitating the inhalation of tubercular bacilli, in only a few they increase and multiply, is hard to explain, but renders the existence of a predisposing cause necessary. Koch believes the denudation of the bronchial mucous membrane after measles renders the lungs liable to bacillar attack; and that, similarly, denudation of the intestinal mucous membrane by the shedding of its epithelium from any cause, offers the chance of infecting this part by the swallowing of bacilli-laden sputum. Moreover, chronic pleurisy or any cause which tends to cripple the movements of the lung, or to prevent the escape of its secretions, will predispose by forming aggregations of epithelial cells, which are the haunt of tubercle bacilli.

The spread of bacilli in the lung may proceed (1) by continuity, through the alveolar wall, the epithelium having been destroyed; (2) by re-inhalation of bacilli-laden sputum, especially if expectoration be difficult—the secretion, being raised by coughing to a point where two or more bronchi join, is drawn by deep inspiration into a fresh set of alveoli; (3) through the lymphatics, as is often seen in the stellate arrangement of grey tubercle round a cavity or caseous centre; (4) through the arteries and veins, the entry of the bacilli into these having been demonstrated by several observers. This is the channel of infection in acute tuberculosis.

With reference to the order in which the various portions of the lungs are involved in phthisis, the posterior apex (Fowler) is first attacked, and the lesions spread downwards along the anterior aspect of the upper lobes; the posterior upper border of the lower lobe is next infected, and tuberculisation spreads again forwards along its upper edge. The posterior region seems to be attacked altogether earlier than the anterior; excavation is commonest and earliest (Ewart) at the apex, next in the dorso-axillary and mammary regions, and later and less common at the base. Cavities in the dorso-axillary and mammary regions are invariably secondary, and generally the result of re-infection of the lung from secretion from cavities.

Symptoms. — (*a*) *Tuberculisation.* — The symptoms of pulmonary phthisis in the first stage may be thus summarised: Cough, becoming more persistent; mucous expectoration; loss of colour and strength; emaciation; night-sweats; sometimes loss of hair; pulse somewhat quickened, though this is not invariable; and a temperature rising above the normal in the afternoon, and sinking below it in the morning. M. Peter has noted in many cases a rise in temperature on the affected side during this stage; and with regard to the general temperature of the body, though slight pyrexia is often present, tubercle-formation is quite possible without any rise of temperature, or may even be marked by a depression, as Surgeon-Major Alcock and others have shown. Pain in the upper parts of the chest is occasionally present; and the number of respirations are generally increased, though this depends on the amount of tuberculisation proceeding. Some hold that dyspnœa is an early symptom and precedes all others, but the writer has found quite the opposite—that patients do not notice their breath to be short until their lungs are seriously involved. Disturbance of the digestive powers, and considerable irritability of the intestinal mucous membrane, with a red line on the gums, are noticeable in some cases, though chiefly in the acute forms. The tongue becomes white, the bowels torpid, and the urine scanty. The most constant of the above symptoms are the persistent cough, with mucous expectoration, and the progressive emaciation; and in many cases so obscure are the beginnings of the disease, that these are the only symptoms discoverable.

Physical signs.—The physical signs, after the first stage, depend to a great extent (1) on the number and aggregation of the miliary tubercles; (2) on the amount of consolidation they give rise to; and (3) on the irritation which their formation causes in the lung.

As a rule, tubercle-formation commences at the apex of one lung, and is detected by the presence of certain physical signs in the supra-scapular, supra-clavicular, or sub-clavicular regions, the signs extending downwards at a later date. The signs vary much in particular cases, but consist at the first in an impairment of the ordinary respiratory murmur by a species of crepitation, differing from the pneumonic crepitation chiefly in its more scattered character, in its being audible with both inspiration and expiration, and in its crumpling nature. Many authors, however, maintain that an earlier sign is the 'wavy' breathing (T. Thompson), or '*respi-*

ration saccadée' of the French (Fournet). A feature especially to be observed is increased loudness of the expiratory murmur. Accompanying these is increased vocal resonance and bronchophony, with more distinct conduction of the cardiac sounds; and percussion discovers dulness of varying shades in one of the above-mentioned regions. When a certain definite amount of consolidation has taken place some impairment of the mobility of one side of the chest may be noticed: this is to be detected under the clavicle, where, if any adhesion of the pleura exists, there may be some flattening. Another significant sign is the dry friction-sound, audible generally in the supra-scapular and scapular regions, and indicating limited pleuritis. The subclavian murmur, formerly much dwelt on, cannot be depended on. The dulness usually appears first above the scapula, next over the sternal end of the clavicle, and gradually extends downwards, being limited generally for a considerable period by the lower border of the third rib.

A careful comparison must be made between the two sides of the chest, and often between different portions of the same side, as otherwise the slighter shades of dulness, and the minor differences in the respiration-sounds, which characterise the presence of tubercle in the lung, will escape notice.

When the crepitation and the wheezing—which may be considered as indicative of irritation in the pulmonary tissue, caused by tuberculosis—have subsided, loud bronchophony, prolonged expiration, and certain varieties of tubular sound, show condensation of the lung-tissue around the neighbouring bronchi; and a certain amount of dulness is to be detected.

(*b*) *Softening and excavation.*—The symptoms which accompany the softening of tubercular masses and their subsequent excavation, are by no means uniform. Many authors associate this stage with marked signs of pyrexia, with copious night-sweats, and increase of cough and emaciation; but this is not always the case, for, according to the writer's experience, the process may go on with even subnormal temperatures, and with gain of weight; but as fresh formation of tubercle often accompanies the softening process, some of the above symptoms, which have been assigned to softening, may be due to the tuberculisation and pneumonia accompanying it. The symptoms which should be most depended upon for the detection of softening are increase of cough and expectoration of a yellow colour, occasionally streaked with blood. If the expectoration be carefully collected and boiled with an equal volume of caustic soda, of the strength of twenty grains to the ounce, and the sediment be then placed under a moderate magnifying power of the microscope, delicate filaments of yellow elastic tissue, of hook-like shape, or else exhibiting the characters of the alveoli, may be detected. The sputum chiefly consists of epithelial and pus cells, with 2 to 4 per cent. of albumen, and a large proportion of phosphates. Various organisms have been found, and in advanced cases the *bacterium termo* with different kinds of micrococci and diplococci; among them the '*micrococcus tetragenus*' of Koch, which appears on the walls of cavities in groups of four micrococci, arranged like the sarcina ventriculi, each group having a diameter of a third of a red blood-corpuscle. The characteristic organism is the tubercle bacillus, which, scanty and often absent from the sputum of early phthisis, abounds in that of softening and excavation, and specially in acute cases. *See* MICRO-ORGANISMS: Modes of Staining Bacteria; and SPUTUM, Examination of.

Physical signs.—The signs which these changes give rise to are often obscure. The percussion-sounds vary: sometimes there is an increase of dulness, possibly due to pneumonia of adjacent lobules; at other times, hyper-resonance, as if air had taken the place of the expectorated masses. In all these cases much depends upon the situation of the lesion. The formation of a cavity deep in the lung, and far from the chest-walls, may take place without being detected (except by the expectoration); whereas the formation of a similar cavity on the surface gives rise to unequivocal signs. Auscultation reveals—where formerly bronchophony and fine crepitus existed—crepitation of a very coarse character, commencing with a *click* sound, and after a while developing into a *croak*. When this last note has been reached, loud tubular sounds become audible on coughing, and we soon get the sounds characteristic of a cavity. The great distinguishing features of these moist sounds of softening are their variety, their short duration, and their concentration over one small portion of the lung. In phthisis, crepitation much more commonly signifies tubercle-formation or pneumonia than it does softening of already formed tubercular masses. The formation of a cavity is generally followed by regular morning expectoration, usually opaque, and nummular in form, and in the majority of cases, unless interfered with by treatment, by the usual train of consumptive symptoms, if these have not already appeared. These are—night-sweats, slightly elevated temperature in the afternoon, and rapid loss of flesh, strength, and colour. The drawn look of the face, the hectic spot on the cheek, the pearly-white colour of the sclerotic, the clubbing of the fingers, and other signs which mark the confirmed consumptive, generally belong to this stage, and all more or less denote blood-infection from the lung-products, sometimes even simulating pyæmia.

The weakness of voice, so common in chronic phthisis, is distinct from the total

aphonia of laryngeal phthisis, and has been shown to be due to granular degeneration of the muscles of the larynx. Marcet states that in phthisis the muscles generally undergo degeneration.

The history of a cavity follows one of four courses. *See also* CAVITY; and VOMICA.

(1) It may remain patent, secreting pus, like a chronic abscess, but not increasing in size.

(2) It may enlarge by caseation and ulceration going on in its walls, by which process blood-vessels may become exposed. In this case the expectoration becomes more nummular and abundant, containing quantities of lung-tissue and remains of bronchi; and excavation may in time convert the lung into a mere pleural bag, devoid of lung-tissue, with what remains of the bronchi opening into it. The physical signs attending this increase in size are amphoric breathing, and often hyper-resonance on percussion, or cracked-pot sound; and the voice and cough may be accompanied by metallic tinkling, especially if the communication with the bronchi is narrow.

(3) It may open into the pleura, and cause pneumothorax or pyopneumothorax. That this does not occur oftener is owing to the adhesive pleurisy which so often accompanies the early consolidations of phthisis, especially if the tubercle be superficial. *See* PLEURA, Diseases of.

(4) It may contract, and the sides approaching each other form at length a firm, tough cicatrix, causing a stretching of the surrounding tissue and often considerable displacement of the neighbouring organs. This is the natural cure of the third stage of phthisis, and is evidenced in most cases by a flattening of the chest-wall, chiefly in the infra-clavicular space, a disappearance of the cavernous sounds, and a substitution of deficient or harsh breathing, and sometimes of healthy sounds over the seat of the cavity. Percussion often discovers that the sound lung is drawn across the median line to the affected side; and if the cavity be in the left lung, the heart and stomach may be displaced upwards, the former organ being generally tilted towards the axilla, the apex describing the arc of a circle, of which the centre is the commencement of the aorta. If the cavity be in the right lung, we may expect the liver to be drawn up, and the impulse of the heart displaced to the right of the median line, reaching occasionally beyond the right nipple. Contraction of a cavity always takes place towards a fixed point, which is sometimes an adhesion of the pleura, but more generally the root of the affected lung; and in this way the remarkable vagrancy of the physical signs is explained; for it is not unusual to find the cavernous sounds audible above the scapula long after they have ceased to be heard in the sub-clavicular region, and again in the inter-scapular regions after they have ceased to be audible in the supra-scapular fossa.

Of these destinies of a lung-excavation, the first two are undoubtedly the commonest. Where the cavity remains quiescent, and no fresh tubercle-formation takes place, the patient may live on for years, with only the inconvenience of regular expectoration and occasional dyspnœa, and preserve the appearance of actual health. Where a cavity continues to increase by further ulcerative processes, tuberculosis soon attacks the opposite lung; and this organ passing rapidly from consolidation into excavation, the cough and expectoration increase, hectic fever becomes more frequent, the patient reaches an extreme state of emaciation, the adipose tissue disappears from all parts of the body, the temporal and malar bones become prominent, the jaws are sharply defined, the scapulæ, ribs, and sacrum all stand out, as if, as is really the case, they were only covered by skin, and the patient becomes to all appearances a mere skeleton. By an all-wise arrangement a kind of balance seems to be maintained between the diminished requirements of the body and the mass of the blood, for this latter is reduced in bulk in proportion to the lessened respiratory surface, and the individual thus gradually dwindles and sinks.

In the last stage of phthisis various symptoms appear indicative of the disorganisation the blood has undergone, and the manifest lowering of the standard of life. Thromboses may arise in the veins of the extremities; œdema of the ankles and feet ensues; bed-sores form on those parts where the pressure is greatest, as, for instance, on the hips, buttocks, and sacrum; and thrush appears on the tongue and fauces, and when removed is succeeded by a fresh crop, rapidly spreading round the hard palate, buccal surface, and gums. Ulceration of some part of the mucous membrane of the mouth and pharynx is not uncommon, the part affected being generally the soft palate, less commonly the hard palate, the edge of the tongue, or the buccal surface in the region of the back molars. Near the end profuse sweats follow the swallowing of all fluids. The breathing becomes quicker, and expectoration more and more difficult. Diarrhœa prevails at this stage, and often proves fatal before the pulmonary lesions have reached their furthest development.

Death may occur in several ways, either—(1) by apnœa, from inability to expectorate; (2) by thrombosis of the pulmonary artery, inducing lividity and dyspnœa; (3) by pneumothorax; or (4) by exhaustion, the heart's action gradually failing, the patient being utterly prostrated, either by the wasting course of the disease or by the attendant diarrhœa. Hæmoptysis may cause death,

either by collapse from loss of blood, or by suffocation through the blood rapidly filling the air-cells.

Some of the principal symptoms of phthisis require a fuller description.

Temperature, Pulse, and Respiration.—The *temperature* of phthisis is both pyrexial and subnormal, its varieties depending partly on the amount of tuberculisation and inflammatory process going on, and partly on the extent to which the constitutional powers are depressed. The high temperatures are due to the former, the low ones to the latter cause. The range extends from 106° or 107° F., noted in acute phthisis, down to 90·5° F. observed by Lebert. The writer has seen morning records as low as 91·6° F. In many cases of quiescent phthisis in the first and third stage, the observations are for the greater part of the day subnormal, and only reach the healthy standard in the afternoon. It is said to be even possible for tubercle to form, and for softening and excavation to take place, without any rise of temperature.

Where, however, tubercle-formation is accompanied by elevation of temperature it is post-meridian, and by no means continuous in character, the phenomena being as follows: The rise commences after 2 P.M. and continues till 8 P.M., when the maximum, which may attain 103° or 104° F., is reached. A fall then begins, and continues till 4 or 5 A.M., when the minimum, which may be as low as 94° F., but is generally about 95° or 96° F., is attained. After this a gradual recovery takes place, and by 10 or 11 A.M. normal temperatures are reached. During the process of softening, the post-meridian rise appears to be maintained later in the day, the maximum being reached at 10 or 11 P.M. In active cases in the third stage, where excavation is proceeding or extending, and where also fresh tuberculosis may be taking place, the thermic chart approaches more closely to that of suppuration and pyæmia, and shows great extremes, the highest and lowest temperatures of phthisis being noted at this stage. The rise commences soon after noon, and continues till 5 P.M., or even till 10 P.M., when the maximum of 103° to 104° F. is reached, and a fall rapidly follows, 95° and 94° F. being very commonly reached before 6 A.M. Then recovery sets in, and normal records are observed about 10 A.M. The chief characteristics of the temperature in phthisis are—(1) the post-meridian form of its pyrexia; and (2) the remarkable fall at night to subnormal figures, showing collapse of the vital powers. Pyrexia is compatible with large gain of weight in phthisis, provided the food-supply is carefully maintained.

Peter maintains that the formation of pulmonary tubercle causes an elevation of from ·5° C. to 1·5° C. above the mean temperature of the body in the intercostal space overlying the granulations; but the writer has failed, after many observations, to verify this conclusion.

The occurrence of hæmoptysis does not generally affect the temperature, unless a large amount of blood has been inhaled into the air-cells. Under these circumstances catarrhal pneumonia is set up, and the temperature remains elevated until its subsidence; or, if it does not subside, but gives rise to secondary tubercle, the chart will assume the pyrexial character of acute tuberculosis. Night-sweats, as a rule, lower the temperature for the time, but they are not to be regarded as a consequence of the pyrexia, as they are noted sometimes in non-pyrexial cases, but rather as a flux from the skin, due to loss of power in its vaso-motor nerves. The influence of diarrhœa on the temperature depends entirely on its form and causation. Where it depends on acidity of the primæ viæ and dyspepsia, it exercises no influence; where it arises from lardaceous degeneration of the intestines, and is accompanied by dropsy, a lowering of the standard may be looked for. Where, as is generally the case, it is due to intestinal ulceration, a decided rise of temperature takes place, generally in the evening, succeeded by equally well-marked morning remissions, if the ulceration is extensive. Albuminuria, from whatever cause arising, tends to lower the temperature, and the more so as the kidneys become more deeply involved, the blood is more disorganised, and dropsy supervenes.

The *pulse* varies greatly, according to the form of the disease, and the amount of lung-surface involved. In the greater number of cases of chronic phthisis its character is weak, regular, and little above the normal standard. In cases of acute disease, it has a frequency of 100 to 140, but its rise, as a rule, follows, sometimes after a long interval, that of the temperature. Considerable changes may take place in the lungs without any rise of pulse.

Respiration varies according to the amount of lung-surface involved, being normal in early quiescent stages, and rapid in cases of extensive advanced disease. Nevertheless in acute phthisis and acute tuberculosis, the respirations are generally rapid, even before the lungs are largely obstructed, and in these cases there is a definite pulse-respiration ratio. In phthisis generally this cannot be said to exist, but the observation of the number of respirations is of far more importance than that of the pulse.

Diarrhœa.—Diarrhœa has a great influence on the course of the disease, and tends more to weaken and emaciate the patient than the harassing cough, the persistent pyrexia, or the drenching night-sweats. In the first stage an opposite condition, namely, constipation, prevails, but in the third stage diarrhœa

is tolerably common and very obstinate in character. It varies in intensity, according to its cause. Sometimes it proceeds from (1) acidity of the primæ viæ and consequent indigestion, and is trivial in character. Sometimes it is due to (2) atony of the intestines, and partakes of the character of a flux, like night-sweats; (3) in other cases it is due to lardaceous degeneration of the intestines, especially of the small intestine, causing increased permeability of the infiltrated vascular walls. The diarrhœa is not always very profuse in these last cases, but it is very persistent, and not uncommonly accompanied by vomiting of a very obstinate kind. Lastly (4) it may originate in ulceration of the intestines, and it has been attributed to the swallowing of bacilli-laden sputum, which is common where expectoration is difficult. Here the diarrhœa is very persistent, the stools ochrey and soft, containing abundant tubercle bacilli, and sometimes streaked with blood; the patient often complains of pain in the abdomen, referred to the seat of ulceration, and feels tenderness on pressure. This is usually found over the ileo-cæcal valve, but it may be traced in cases of extensive ulceration throughout the whole of the ileum, into the colon (ascending, transverse, and descending), and the sigmoid flexure. Flatus and a tympanitic condition of the abdomen are often present in extreme cases. The diarrhœa prevails most at night, but in advanced instances continues day and night, and exhausts the patient greatly. Ulceration, according to *post-mortem* examinations, commences at the ileo-cæcal valve, and involves the solitary and Peyer's glands, tubercular ulcers being more irregular in form and often deeper than those of enteric fever. They are scattered through the duodenum and ileum, but are always more advanced and extensive in size in the large intestine, which is often a mass of ulceration, this being attributable to the long retention of fæces and the disengagement of foul gases in this portion of the intestinal tract.

State of the Blood.—The principal changes in phthisis are a diminution of the red corpuscles (Malassez), and of the hæmoglobulin (Quinquand); and an increase in the number of leucocytes, and in the proportion of fibrin and phosphate of calcium. In advanced cases aggregations of granules, varying in size from $\frac{1}{10}$ to $\frac{1}{2}$ a red corpuscle, have been observed. The masses are often large enough in size to occupy a considerable part of the field of the microscope; and when observed at a temperature of 98° or 100° F. these granules show amœboid movements in the blood. Their nature and function are unknown, but they are regarded as an altered form of leucocyte.

Varieties.—We have hitherto traced the course of a typical case of consumption in its various stages, and we must now draw attention to the different forms the disease includes, always premising that while they differ in symptoms, in prognosis, and in duration, they cannot be described as distinct pathological varieties, as they are merely forms of the same disease, and between each is to be found every kind of anatomical and clinical connexion.

The following table gives the principal forms:—

I. *Acute.*—(1) Acute tuberculosis; (2) Scrofulous pneumonia, or acute phthisis; (3) Acute tuberculo-pneumonic phthisis.

II. *Chronic.*—(4) Catarrhal phthisis; (5) Fibroid phthisis; (6) Scrofulous phthisis; (7) Hæmorrhagic phthisis; (8) Laryngeal phthisis; (9) Chronic tubercular phthisis.

1. Acute Tuberculosis.—This term is restricted by the Germans to cases of general tuberculosis where more than one serous membrane is affected with tubercle, in addition to the lung; but it is here used to denote all acute pulmonary cases where miliary tubercle, which has not begun to caseate, is the principal lesion. The history is as follows: A young person of either sex is attacked with feverish symptoms, pungent heat of body, rapid pulse, extreme oppression, and overwhelming weakness, dry-coated tongue, red at edges, soon becoming brown in the centre, sordes on the teeth and lips, gastric disturbance and diarrhœa, and occasional delirium, the symptoms closely resembling those of enteric fever, for which the disease is often at first mistaken. Cough and slight expectoration come on; fine crepitation and bronchial rhonchus take the place of the ordinary vesicular sounds; and occasionally some dulness is detected over the posterior regions of the chest. The patient wastes rapidly; the breathing becomes more and more embarrassed; the sputum rusty; the crepitation more general and louder. Later on, the symptoms of collapse appear—the pulse becomes more rapid and feeble, the aspect ghastly or livid, cold perspirations appear; and death occurs within a few weeks from the date of the first onset. Or the symptoms may be more cerebral in character, denoting that the meninges are the seat of miliary tubercle. The patient complains of pain in the head, vomiting, and intolerance of light; begins to mutter and to give wrong answers; and then has marked delirium. The aspect is heavy and confused; hyperæsthesia of skin appears (Empis); and double vision, though squinting is not always noticeable. Granulations can often be detected with the ophthalmoscope in the fundus oculi. Twitchings of the muscles of the extremities and sometimes of the face occur, followed by convulsions, and by paralysis of the sphincters. Dilatation of the pupils and other signs of effusion supervene, and the patient dies comatose. In this variety, as a rule, the temperature remains continuously high (be-

tween 100° and 102° F.), but in some instances it may be observed to rise above 100° F. for the last ten days of the patient's life. After death the lungs are found highly congested and pervaded with miliary tubercle, soft in character, but devoid of caseation and containing abundant tubercle bacilli; the bronchi are full of frothy mucus; and tubercle may be found in the pleura, peritoneum, or brain-membranes, with effusion into the ventricles. This form is distinguished from capillary bronchitis by the presence of fever; from enteric fever by the different physical signs; from scrofulous pneumonia by the great dyspnœa and scanty expectoration; and by the head-symptoms (when present) from all the above.

Acute tuberculosis is the most fatal form of consumption, terminating in a few weeks or even days, and is characterised by gastric disturbance, by the presence of family predisposition (Pollock), and the absence of hæmoptysis. It may be primary or secondary, but in each case is equally fatal.

2. **Acute Phthisis.**—Acute phthisis, or scrofulous pneumonia, is another very acute variety. The patient, generally young, who may have had cough previously, is attacked with sharp pain in one side of the chest, quick pulse, high temperature, the skin being quite burning to the ear of the auscultator, alternating with night chills and sweats. The general appearance betokens pneumonia, but the crepitation commences at the apices, extending to the whole lungs, and is not so fine and even as in pneumonia. The cough increases; the expectoration becomes opaque and purulent, containing quantities of lung-tissue and swarms of tubercle bacilli; and the temperature assumes the intermittent type. The physical signs show at first gradual consolidation of both lungs, but later on indicate that excavation has taken place; and this continues, the patient rapidly wasting and dying in a few weeks. Sometimes the cavity opens into the pleura, which in these cases is rarely adherent, and death ensues by pneumothorax. This form is not quite so hopeless as acute tuberculosis; and in some instances the disease may stop short of utter lung-destruction and become chronic, the patient remaining in a state of crippled respiration and of health for months and even years. Such cases may last for periods extending from three and a half to sixteen years. After death the lungs are found more or less consolidated, with adherent pleuræ, the indurations consisting of red hepatisation and caseous infiltration, the latter largely predominating. Excavations abound in all directions, and but little or no miliary tubercle is present. The characteristics of this form, are (1) the acuteness of the disorganising processes, excavation quickly succeeding consolidation; (2) the inflammatory nature of the lesions, and the rarity of miliary tubercle; (3) the occurrence of pneumothorax; and (4) the freedom of other organs from tuberculosis.

3. **Acute Tuberculo - pneumonic Phthisis.**—This is a third variety, which constitutes a connecting link between the above forms, scrofulous pneumonia and acute tuberculosis, as it presents some of the clinical and pathological features of each, resembling the latter in so far that the tuberculisation takes place rapidly in the lungs, and often involves other organs, as, for instance, the intestines; and being more akin to the former in the presence of consolidations of a pneumonic origin, yet differing from them both in that the tubercle aggregates, tends to caseate, and thus to form cavities, through the breaking down of tubercular masses and not of catarrhal pneumonic products, this occurring while rapid tuberculisation is taking place in another part of the lungs.

4. **Catarrhal Phthisis.** — Catarrhal phthisis somewhat resembles the last-named variety, and has its origin in bronchitis, which has gradually passed into catarrhal pneumonia. The patient has been subject for years, perhaps, to attacks of winter catarrh, which disappear in summer; and at last, owing to a severe season, or from his being in less favourable circumstances than usual, his cough does not cease, as formerly, but remains persistent, and is accompanied by some purulent expectoration, loss of flesh, and night-sweats. The bronchial *râles*, sonorous and liquid, as they disappear from certain parts of the lung, become more prominent and localised in others, especially under the clavicles, and above and between the scapulæ. The *râles* become coarser, and the sonorous rhonchus assumes a croaking character. Signs of consolidation soon appear, but are never so prominent as in other forms, owing to the temporary emphysema accompanying the bronchitis; the dulness appears in patches over the centres of increased rhonchus; the liquid *râles* diminish, owing to increasing obstruction, and give place to a tubular sound conveyed by the extending consolidation from the larger bronchi, and heard best in situations overlying them. as below the clavicle, and above and within the scapula, in the axillary and middle dorsal regions. The tubular sound has a sharp, whiffing character, and is often unaccompanied by bronchophony, from the consolidation being insufficient, and the bronchial tubes too choked to produce it. If the case goes on unfavourably, the expectoration becomes more abundant, and is found to contain both tubercle bacilli and shreds of lung-tissue, and excavation is proved to have taken place, with the usual symptoms; the patient assumes all the appearances of advanced cavity-phthisis, and the case from this date can hardly be distinguished clinically from those of a strictly

tubercular origin. After death the lungs are found to be more or less consolidated, the indurations taking the direction of certain lobules and generally not affecting entire lobes. The indurations are of a grey or yellowish tint, with numerous yellow masses of caseation intervening, which abound in tubercle bacilli. Another form of catarrhal phthisis follows on attacks of unresolved pneumonia or of pulmonary affections tending to lung consolidation. Portions of the lung may be found in the first stage of catarrhal consolidation, so well described by Dr. Hamilton, with isolated lobules or groups of lobules of a leaden or purple colour, and the adjoining ones may be emphysematous. Wedge-shaped patches of consolidation can be traced on the pleural surface, exuding on section yellow catarrhal fluid similar to that contained in the bronchi. Numerous excavations of irregular form are seen containing bacilli, but in most instances no trace of tubercle is to be found, though it is occasionally present. The bronchi are generally dilated, and full of purulent matter. This form is more common among the young than the old, and arises from whooping-cough, measles, and bronchitis, the pathology being extension of catarrh from the bronchi to the alveoli, implication of the interstitial tissue, large epithelial proliferation, causing pressure and emptying of capillaries, degeneration and caseation of the alveoli and their contents, and consequent excavation, with occasionally lymphatic infection.

5. **Fibroid Phthisis.**—This term, introduced by the late Sir Andrew Clark, is applied to cases of which fibrosis is the principal feature. While this process accompanies most instances of chronic phthisis, it specially characterises those in which interstitial pneumonia is present, and entirely modifies their history and symptoms. It is generally secondary to attacks of pleurisy and pleuro-pneumonia, or to chronic pneumonia, resulting from long-continued irritation of the lungs, through the inhalation of dust or grit, as prevails among fork and knife grinders, colliers, and button-makers. Taking the pleuritic origin as an example, the following are the symptoms.

A patient has an attack of pleurisy with effusion, from which he recovers with absorption of fluid; but percussion shows dulness over the whole side, and somewhat feeble respiration. The patient experiences dragging pains in the side; a dry, hacking cough, somewhat paroxysmal in character, with little expectoration, continues; and the breathing, always short, becomes still more so on exertion. These symptoms increase, and a few months later we find marked immobility of the affected side, dulness throughout, and now considerable shrinking, the circumference of this side measuring one or two inches less than the healthy side. On auscultation we notice the breathing to be very deficient in some parts, and in others bronchial, and sometimes cavernous in character; but generally there is everywhere absence of true vesicular breathing. Careful percussion of the opposite side of the chest shows the line of resonance to extend beyond the usual limit, passing to the edge of the sternum, and often an inch or two farther; demonstrating that the contraction of the affected lung has caused the healthy one to be drawn across. Other organs are likewise displaced. If the left lung be affected, the heart is tilted, not necessarily upwards, as when a cavity is contracting, but outwards. The stomach rises, its note being audible as high as the fourth rib. The heart is not only displaced, but is uncovered by the retreating lung; and the right auricle and ventricle are clearly distinguished by their pulsations. If the right lung is affected, the left may be drawn over, and the area of resonance may extend as far as the inner half of the right clavicle, and a line drawn thence sloping towards the middle of the sternum. The heart is transposed, and its impulse may be traced in the fourth interspace on the right side. The liver rises up to the fifth rib, and shrinking of the chest-walls takes place, as on the other side. The expectoration, if there be any, has been occasionally but rarely found to contain tubercle bacilli. The pulse may be slow; the respiration often rapid, rising to 50 and 60 per minute. The temperature seldom rises above the normal and is sometimes subnormal. When the temperature rises over 100° F. it signifies that something beyond fibrosis is going on. The cough is troublesome, and often induces vomiting; and the expectoration becomes more and more difficult, and in time, on account of retention, fœtid. Meanwhile the dyspnœa increases, the other lung becoming involved; signs of obstructed circulation appear; dropsy of the extremities takes place, and rapidly increases; the urine becomes albuminous; and the patient dies, either of dyspnœa or of uræmic poisoning, his death contrasting strongly with the ordinary termination of consumptive disease. The patient may, however, die of apnœa, without albuminuria or dropsy. After death we find a lung contracted to the size of a man's fist, with enormously thickened and adherent pleura, and widely dilated bronchi, with interlobular septa much increased in size and encroaching on the lung-structure, which seems to be replaced by a fibrous hard tissue, in parts mottled with grey, deeply pigmented, and resembling cartilage in its resistance to the knife. Imbedded in this structure are found caseous and cretaceous masses, or, again, excavations of various sizes; the walls of these and of the dilated bronchi being rigid and inelastic, from the presence of the fibroid material, and thus affording some explanation of the difficult

expectoration and consequently troublesome cough. Careful examination of microscopic sections of this fibroid tissue have, according to Sir Andrew Clark, Watson Cheyne, and Percy Kidd, failed to detect tubercle bacilli; but in the caseous masses imbedded in it Watson Cheyne has found them. Besides these changes, we may find the other lung the seat of tuberculosis, though this is not constant; but commonly the bronchial glands are hardened and deeply pigmented. There is often amyloid disease of the liver, spleen, and kidneys.

6. **Scrofulous Phthisis.** — This is a variety where consumptive disease of the lung is preceded by, or accompanies, scrofulous affections of various joints, caries of the sternum, ribs, and vertebræ, lumbar and psoas abscesses, otorrhœa, fistula in ano, or, as is most common, enlarged and caseating glands—cervical, bronchial, axillary, or mesenteric. Rindfleisch explains the non-absorption of scrofulous matters by the presence in exudations of this character of relatively large cells with glistening protoplasm, and by the fact that the emigrated leucocytes, which pass from the blood-vessels of the inflamed part into the adjoining structures or into the lymphatics, in scrofulous persons tend to grow larger on their way through the connective tissue, by absorption of albuminous substances. The large size of the cells has been verified by Godlee, Schüppel, Green, and others. Cases of scrofulous phthisis show an early infection of the lymphatic system, and a remarkable correlation appears to be established between the external gland or discharging surface and the condition of the lungs. If the glands are suppurating, or if the fistula is open, or if the carious bone freely discharges, the lung-disease will remain quiescent, and progress may be made towards arrest; but if, on the other hand, any of the above discharges, in the most of which tubercle bacilli have been detected, should be checked or cease, the lung-disease passes into fresh activity, making considerable advance and extension. This has been used as a strong argument against operating on fistula in ano if the lungs have been affected. The temperature-course in these cases, if active lung-changes are taking place, is remarkably fitful, showing evening exacerbations of 102° to 104° F. and morning depressions of 96° to 97° F.; and night-sweats are usually very profuse. Patients of this type lose and gain flesh with great rapidity, owing probably to the pyrexia and fitfulness of the appetite.

Scrofulous phthisis is strongly hereditary; it prevails chiefly among children not exceeding fifteen years, as shown by Pollock, many of these presenting the well-known strumous aspect, the clear complexion, enlarged glands, chronic inflammation of the eyelids, or discharging ears. They are attacked early with hæmoptysis, accompanied by cough and wasting. The course of the disease, probably on account of the relief afforded by the various discharges, is slow, and the patient lives on for a considerable period; but, as might be expected, the development of the individual is slow and often stunted. *Post-mortem* examination generally shows the ordinary destructive lung-changes of advanced tubercular phthisis, with considerable enlargement of the various glands—bronchial, mesenteric, cervical, &c. The characteristics of this form are (1) the relation of the lung symptoms to the state of the other organs affected; (2) the tendency to excavation, and to cavity-contraction; (3) its distinctly constitutional character; (4) the great extremes of the temperature-chart; (5) the rapid changes in the patient's weight.

7. **Hæmorrhagic Phthisis.**—This name is intended to designate, not phthisis arising from the results of hæmoptysis (*phthisis ab hæmoptoë*—Niemeyer), but a form recognised by C. J. B. Williams, Peacock, Hughes Bennett, and the writer, in which large and repeated hæmorrhage is the principal feature, associated with a small amount of detectable disease. It is more common among men than women, in the proportion of five to one; and the period of attack is later than in the ordinary forms, possibly owing to the element of heredity being generally absent. The patient may have had signs of failing health before the hæmoptysis, but often he is apparently in good health when he is suddenly attacked with profuse hæmoptysis, the blood being florid, the hæmorrhage sometimes lasting many days, and always causing a reduction in flesh and strength. Cough and expectoration follow, yet examination of the chest only indicates slight signs, and sometimes none at all. When present they are to be found in the supra- or inter-scapular regions, or below the clavicle. The patient improves, and often entirely loses his cough before the recurrence of the hæmorrhage, which may not take place for days, weeks, months, or even years. If the attacks recur often, the cough becomes persistent; the expectoration, when not sanguinolent, is muco-purulent; wasting and night-sweats appear; and the physical signs now show unmistakable consolidation, which goes on to softening and excavation. In most cases the disease does not extend beyond consolidation, and large quantities of blood are expectorated without fatal results, the patients recovering in the intervals, and sometimes living to a considerable age. Peacock stated that in most instances some more or less exciting cause of a depressing character is to be detected, in the form of syphilis, cold, dysentery, bodily strain, exertion of voice; but the observer will often fail to find one. The exact pathology of this form of phthisis is uncertain, because few of the patients die

in the early stage; but it is probable that the hæmorrhage is produced by the erosion of the pulmonary vessels by bacillar invasion, masses of tubercle bacilli having been shown to be present in the walls of both arteries and veins by Weigert, Koch, Mugge, and Percy Kidd; and in hæmorrhagic phthisis it is probable that the larger vessels are thus attacked. Though this can be considered only a clinical variety of pulmonary phthisis, the cases are genuine instances of consumption, as is proved by the fact that, if the patients live long enough, they present the same phenomena of increasing consolidation and excavation as ordinary phthisis.

8. **Laryngeal Phthisis.**—*See* Larynx, Diseases of.

9. **Chronic Tubercular Phthisis.**—This constitutes the ordinary type as sketched under the head of Symptoms. In the necropsies of this form are to be found all the pathological elements of phthisis, namely, tubercle—miliary, grey, and white, caseous masses, and infiltration—grey and catarrhal, croupous pneumonia, fibroid tissue, and calcareous deposits, showing that no abrupt pathological line of demarcation can be drawn between the different varieties of phthisis, whatever clinical peculiarities they may present; and that the appearance of miliary tubercle is a matter of infection of the lymphatics, in which time plays an important part.

Diagnosis.—Phthisis is distinguished from other chest-affections principally by the evidence of physical signs. The evidences of consolidation separate it at once from bronchitis; while the tendency of the signs to become localised in the apices of the lungs, their special characters, and the combination of consumptive symptoms, distinguish it generally though not invariably from pneumonia.

Of the various forms of phthisis, the most difficult to diagnose from other diseases is acute miliary tuberculosis, which at its onset is sometimes mistaken for acute bronchitis, from the fine *râles* and rhonchi accompanying the miliary formation. It has also been confounded with enteric fever, from the high pyrexia, the depression of the patient, and the occasional diarrhœa accompanying it; but in both cases the rapidly advancing symptoms, and the steadily progressing physical signs, such as increased and scattered crepitation, if frequent careful examinations be made, ought to leave us in no doubt as to the naturo of the case.

The diagnosis between scrofulous pneumonia (acute phthisis) and croupous pneumonia is not easy at the ushering in of these complaints, the physical signs not always sufficing for this purpose. In a short time, however, tho detection of tubercle bacilli, and later of lung-tissue in the sputum, and tho rapid wasting, make matters quite certain.

The diagnosis of chronic tubercular phthisis from anæmia and chlorosis, sometimes confused with it on account of the amenorrhœa often common to both, is made by the physical signs; by the different kinds of pallor in the two diseases; and, lastly, in chlorosis, by the absenco of wasting. The diagnosis of excavation in phthisis from bronchiectasis is by no means easy, as the position of the cavernous sounds is not always sufficient to determine the nature of the lesion. Dilated bronchi are found in the subclavicular and interscapular regions, and where ulceration is proceeding in bronchiectasis lung-tissue may be detected in the sputum; but the presence of tubercle bacilli at once settles the question in lesions of phthisis, while the convulsive character of the cough, and the fœtid expectoration, abundant, but mixed largely with air, generally enable us to decide in favour of dilated bronchi.

Duration and Prognosis.—Early detection of the disease, and improved treatment, have worked a great revolution in our ideas as to the *duration* of phthisis.

The estimates of Laennec, Louis, Bayle, and others assigned two years as the mean duration of life in phthisis generally. Pollock's statistics, founded on between 3,000 and 4,000 hospital cases, give a considerable extension of this, inasmuch as at the end of two years and a half the majority were sufficiently recovered to have a fair expectation of life.

The statistics of C. J. B. Williams and the writer, founded on 1,000 cases among the upper classes, give an average duration in 198 deaths of 7 years 8·72 months; and in 802 living of 8 years 2 months. The fact of these patients having all been one year and upwards under observation necessarily excludes some of the acute cases; but with this limitation these figures, striking though they be, may be taken as a correct average for the duration of the disease among the upper classes under modorn treatment, especially as 72 per cent. of the living had recovered sufficiently to pursue their usual avocations, and many among them had already lived upwards of twenty years since their first attack. The duration of the disease is found to be considerably influenced by age; for it is longer in proportion as the age of attack is later, this retarding influence being more conspicuous among males than females. Females are attacked earlier, and tho disease in them runs a shorter course by nearly two years than among males.

Of the varietios of phthisis, acute tuberculosis is the most rapid in its course, generally terminating in a few weoks, or occasionally in a few days. Scrofulous pneumonia has hardly a less rapid course, though it may occasionally be retarded, the disease becoming chronic, and the patient surviving

for many years. Laryngeal phthisis has a short duration, and most unfavourable prognosis. Catarrhal phthisis has an average duration somewhat below the average of eight years of ordinary phthisis. Fibroid phthisis, on the other hand, exceeds the ordinary duration by nearly two years. Hæmorrhagic and scrofulous phthisis are both of long duration. These calculations are based on statistics of patients of the upper classes treated according to the best medical and hygienic treatment known; but if hospital cases are reckoned, the average duration of phthisis generally, and of its various forms, must be held to be much lower than the above estimate.

The prognosis in phthisis depends chiefly on the extent to which the system is infected, and especially whether or not other organs are the seats of tubercle. Cases of acute tuberculosis resemble closely those of pyæmia in their symptoms and fatal course, and only differ in the nature of the pathological products. Similarly single-cavity cases, where the disease is strictly limited, bear a strong resemblance to chronic abscesses, which go on discharging for long periods, without materially curtailing the life of the patient. The future, therefore, of the patient depends to a great extent on whether the disease may be considered local or general, though of course we admit in both instances a constitutional predisposition, possibly of different degrees of intensity. Where the infection is rapid and complete, as in acute tuberculosis and most instances of scrofulous pneumonia, the prognosis is most unfavourable. Where, again, the disease is limited to one lung, and associated with similar processes in the joints, as in scrofulous phthisis, which act as diverticula to the central disease, the prognosis becomes far more hopeful, and the individual may last on for many years.

The prognosis in laryngeal phthisis is most unfavourable, in consequence of these cases being always associated with extensive lung-tuberculosis; while in hæmorrhagic phthisis, where the pulmonary mischief is small and limited to the root of the lungs, it is favourable, excepting of course the accident of death during an attack of hæmorrhage. The most favourable prognosis of phthisis must be retained for cases of inflammatory origin, for here the disease often remains limited for considerable periods of time, and the patient may live on, almost unconscious of it, to the natural term of life. If, however, the fibroid element be largely produced, a new danger arises from the obstruction to the circulation caused by the contraction of the lungs, which may be followed by dilatation of the heart, dropsy, and death.

The influence of *heredity* on prognosis lies in its precipitating the onset of the disease, and not in its curtailing its duration, though, of course, an individual attacked earlier will die at an earlier age, the duration of the disease being the same. Maternal inheritance is worse for the children of both sexes than paternal, for while the father transmits with the disease a certain degree of resisting power, the mother transmits with the disease the lack of resisting power which is the characteristic of her sex. The influence of *stage* must be duly taken into account, for statistics show a far more favourable prospect for mere consolidation than when a cavity is formed, and this is obvious from the increase of danger arising from two sources, namely, from purulent infection and pulmonary aneurysms. The use of mountain climates is believed to have improved the prognosis of tubercular consolidation, and to have increased the percentage of recoveries in this stage.

The grounds for an unfavourable prognosis are: (1) rapid extension of disease or of lung-excavation; (2) persistent afternoon pyrexia; (3) symptoms of great irritability of the gastro-intestinal tract, red tongue, diarrhœa, pain in the abdomen; (4) great wasting with, or without, pyrexia, combined with a good appetite; (5) strong hereditary predisposition, showing itself in several brothers and sisters being attacked at an early age; (6) the presence of albumen in the urine, with or without some form of dropsy; (7) marked dyspnœa, especially if not warranted by the condition of the lungs; (8) the existence of considerable excavation in both lungs and the occurrence of pneumothorax.

Treatment.—The treatment of phthisis may be considered under four heads: (1) *treatment by inoculation*; (2) *medicinal*; (3) *dietetic* and *hygienic*; and (4) *climatic*.

1. *Inoculation*.—In 1890 Koch introduced the treatment of phthisis by hypodermic injection of *tuberculin*, a glycerine extract of a pure cultivation of tubercle bacilli, in which the parasites had been killed; and maintained that early-stage cases could be cured after four to six weeks of this treatment. Subsequent experience from all parts of the world did not confirm this statement, but demonstrated that, while tuberculin had a strong affinity for tuberculous lesions in various organs of the body and gave rise to characteristic constitutional reactions, it caused breaking down of the tubercular masses, and of the lung-tissue in their immediate neighbourhood, fresh eruption of tubercle, and extension of old cavities, the sputum containing an increased number of tubercle bacilli, and a considerable amount of lung-tissue. Virchow found in the necropsies of patients treated by this method various kinds of pneumonia, including what he termed 'injection catarrhal pneumonia,' and in one case tubercular meningitis, which he attributed to this treatment. Klebs extracted from tuberculin

an albumose called tuberculocidin, by treating it with platinum chloride, and certain alkaloids, and attributed to it the power of arresting tubercle; and these and other modifications of tuberculin have been tried in the treatment of phthisis, without any success.

2. *Medicine.*—The medicinal treatment must be directed to four objects: firstly, antiphthisical, to raise the standard of nutrition and to fortify the individual against the bacillar invasion; secondly, antiseptic or bacillicide, to promote the destruction and elimination of the bacillus tuberculosis; thirdly, to reduce and allay the local inflammations and congestions which accompany and considerably complicate the tubercular changes; and, fourthly, to relieve the various urgent symptoms. The first object is carried out by tonics, such as iron, quinine, arsenic, the mineral acids, and, above all, cod-liver oil, which has been shown to be the most effective agent of all in improving nutrition and rendering the individual less liable to bacillar attack. Some precautions are, however, necessary to ensure its being tolerated for long periods. The pale oil should be preferred, and ordered in doses of from ʒj to ℥ss shortly before or after meals. The best vehicles for it are the vegetable bitters—such as gentian, calumba, quassia, nux vomica and strychnine, hop, camomile, and cascarilla—combined with an acid or alkali, according to the state of the gastric mucous membrane, and rendered more palatable by the addition of tincture or infusion of orange peel, or syrup of ginger. Various other vehicles are used, such as milk, salt and water, lemon-juice, orange wine, and sherry; while many patients, especially children, take it best in an emulsion, composed of cod-liver oil, a few drops of liquor potassæ or liquor ammoniæ, with an essential oil, like that of cloves or cinnamon, to cover the taste. In the great majority of cases cod-liver oil is well borne, if exhibited with discretion. Other oils are of use, but few equal the cod-liver oil in efficacy, on account of its great penetrative power, and of its forming with the biliary and pancreatic juices a compound easily absorbed by the lacteals. Malt extract and similar preparations, though of greatly inferior nutritive power to cod-liver oil, often cause increase of weight, chiefly by assisting the patient to digest more starch, and are often with advantage combined with cod-liver oil, forming a palatable compound; but the stimulating quality of the malt sometimes causes increase of the patient's cough, and does not augment appetite. Of greatly inferior utility to the oil are the preparations of phosphorus and sulphur.

In France the sulphur springs of Eaux-Bonnes, Cauterets, Bagnères-de-Luchon, and Bagnères-de-Bigorre are largely frequented by consumptives, the ground of this treatment being that the results of Claude Bernard's experiments show that sulphur when absorbed is excreted through the respiratory mucous membrane. Peter considers that any benefit that may accrue is owing to the influence of sulphurous acid on the catarrhal conditions. Arsenic appears to exercise a most beneficial effect in those consumptives who can digest it, and often under its influence fever and night-sweats disappear, and weight is gained; and the arsenical waters of Mont Dore, La Bourboule, and Royat are much frequented by consumptives.

The second object of treatment is antiseptic. The admixture of antiseptics with tubercle and tuberculous sputum has rendered the inoculation of guinea-pigs and rabbits with them harmless, namely, sulphuretted hydrogen, iodide of mercury, corrosive sublimate, iodine, carbolic (2 to 3 per cent.) and boric acid, helenine, creasote, phenyl-acetic and phenyl-propionic acids, and sulpho-carbolate of sodium. Some were actually mixed with tubercle, and then injected; others were injected afterwards, separately from the virus. All, when used in sufficient strength, were successful in checking the evolution of the disease in animals, and have been used in consequence in phthisis; but only with very moderate success. Moist heat is, however, the most powerful bacillicide; tubercular sputum can be rendered innocuous by exposure to a boiling temperature. The application of antiseptics has been made—(1) through the air-passages by sprays, inhalations, and 'antiseptic respirators'; (2) by hypodermic injection; (3) by injection per rectum of sulphuretted hydrogen and carbonic acid (Bergeon); (4) through the stomach as medicines; and (5) by intra-pulmonary injections through the wall of the thorax into tubercular cavities. It cannot be affirmed that any of these forms of antiseptic treatment have succeeded in destroying the bacillus or in counteracting the effect of the ptomaïnes which it is supposed to propagate; and far better results have been obtained by constitutional measures which render the individual less vulnerable to bacillar attack.

The third object of treatment, the reduction of local inflammation, is best accomplished by mild antiphlogistic means, such as salines, with or without antimony; and counter-irritation to the chest-wall by blisters, iodine, or vesicating liniments, mustard, or the milder but still effectual application of linseed-meal poultices. Steady continuance with these will often render sedatives for the cough unnecessary. The *pyrexia* in many cases does not require special treatment, but will subside under the general measures directed towards the reduction of local inflammation. Where this is not the case, and the excessive temperature,

rising to 103° to 105° F., torments and wastes the patient, phenazone (gr. x.–xv. every four hours) during the pyrexia, acetanilid and phenacetin (gr. v. twice a day), salicin (gr. v. to x. every four hours), or tincture of aconite (♏ v.) with digitalis, will cause temporary lowering of the body heat, with free perspiration.

The fourth object, namely, the palliative treatment, includes that of the various urgent symptoms.

The *cough*, when not reduced by the counter-irritation, may be to a certain extent allayed by a combination of sedatives, such as opium and its alkaloids, conium, henbane, diluted hydrocyanic acid, American cherry, with mild expectorants, of which chloric ether, lemon juice, and squill are examples. Where the cough is frequent and the expectoration difficult, and there is proof of active disease, tubercular or pneumonic, proceeding in the lungs, an effervescing saline, containing carbonate of ammonium, with small doses of opium and antimonial wine, taken two or three times at night, will greatly relieve the symptoms, the rule in the treatment of consumption being to restrict the sedatives, as far as possible, to the night, so as not to interfere with the appetite and digestion. The preparations of tar, in the form of capsule, pill, or solution, are useful in reducing profuse expectoration. The inhalations of iodine, compound tincture of benzoin, carbolic acid, creasote, larch, and turpentine are useful if expectoration is offensive or requires stimulating; or, again, those of chloroform, conium and hop, when the cough is convulsive and dry.

The *pains* in the chest may be alleviated by blistering, painting with tincture of iodine, or stimulating liniments, such as turpentine and ammonia; or else on Dr. Frederick Roberts's plan, by securing the immobility of the side by strapping.

Night-sweats, when profuse, may be reduced by oxide of zinc (gr. ij. to iv.), by gallic or sulphuric acids, by sulphate of iron, by arseniate of iron (gr. $\frac{1}{6}$ to $\frac{1}{3}$), or most effectually of all by the preparations of belladonna, in the form of the extract (gr. $\frac{1}{4}$ to gr. 1), or as the solution of sulphate of atropine (♏ j. to ij.), or used hypodermically; but these often cause dryness of the mouth and fauces. Dover's powder in 10 gr. doses is useful, but nitrate of pilocarpine (gr. $\frac{1}{20}$), and picrotoxine (gr. $\frac{1}{60}$, in form of a pill), are more effectual.

Diarrhœa, where due to bilious derangement and an acid state of the primæ viæ, is best treated by mercurial aperients, combined with carbonate of sodium or lime water. Where it partakes of the nature of a flux, accompanied by a pale tongue and great debility, it may be checked by astringents, such as hæmatoxylum, catechu, krameria, bael, and carbonate or subnitrate of bismuth. When ulceration of the intestine is present, it is generally but not always characterised by a red, irritable tongue, pain and tenderness of the abdomen, and persistency of the diarrhœa. Here, as in other forms of ulceration, opium and its alkaloids answer best, and may be given internally with sulphate of copper (gr. $\frac{1}{4}$ to $\frac{1}{2}$) every three or four hours. When the stomach is too irritable to tolerate medicine by the mouth, opium or morphine suppositories are useful, but still better are opiate enemata, which, acting more directly on the ulcers, check the pain and diarrhœa, and often afford considerable relief. The amount of injection to be used at a time must be regulated by the probable extent of ulceration; and as a vehicle, in cases of irritability, linseed tea will be found most serviceable. In very obstinate cases tannic acid (four to five grains) and acetate of lead (three to four grains) may be added to the injection. The opposite state of bowels, namely, constipation, is very common in the early stages of phthisis, and is best corrected by changes in diet, such as the use of brown bread and oatmeal, cooked and fresh fruit, regular exercise, and, if these prove insufficient, a mild aloetic or rhubarb pill, or the use of some mineral water, as Friedrichshall, Pullna, Carlsbad, Æsculap, Rubinat, Hunyadi Jânos, and others.

The *dyspnœa* of advanced cases generally arises from difficulty of expectoration and the greatly curtailed respiratory power, and may be relieved by spirit of ether, carbonate of ammonium, and other diffusible stimulants, or by the inhalation of oxygen or of iodide of ethyl (capsules ♏ iij. to v. for inhaling). The pain arising from perforation in pneumothorax is best treated by diffusible stimulants, and strapping the side to limit the movements of respiration; and if much liquid effusion or accumulation of air takes place, it is sometimes advisable to tap the chest; but, as a rule, the state of the patient does not allow of very active measures.

Bed-sores should be prevented by the use of a water-bed, and the skin of the dependent parts can be fortified by a lotion of spirit and water (1 part in 4). If a bed-sore has formed, it is best to protect it from friction by the use of circular air or down cushions, or thick felt plaster, and the raw surface can be painted with collodion, or be regularly dressed.

3. *Diet*.—The great object being to introduce as large a quantity of nutritious food as can be digested, abundance of meat, plainly cooked, with fresh vegetables, and a fair amount of bread and starchy food, should be given. Fatty material, if it can be digested, should be largely represented in the dietary, and many physicians advise large quantities of cream, butter, and suet; but, considering the large amount of fatty matter included in cod-liver oil, which is a severe test at first to

the digestive powers, it is not advisable to increase the amount of fat until the oil is well tolerated. Milk, if it agrees (1 to 1½ pint a day), alone or with lime water, is a staple food for the consumptive; and when cow's milk disagrees, ass's or goat's—the unpleasant flavour of the latter disguised by orange-flower water—may be substituted with advantage. Koumiss and Kèfir, prepared from fermented mare's or cow's milk, are frequently used in Germany and Russia, but they have not become popular in this country. The digestive powers being, as a rule, weakened, much good may be done by the addition of animal ferments, such as liquor pepticus and liquor pancreaticus, to the food, which, becoming peptonised, is much more easily assimilated (*see* PEPTONISED FOOD). In the early stages stimulants are not largely required, as they increase the cough and lung-irritation; but when the strength fails, and the powers of digestion are weak, they may be given frequently in the form of brandy or whisky, and advantageously combined with liquid nourishment, such as eggs, soups, various meat-essences and panadas, arrowroot, and jelly. When wine is required, in chronic cases, it will be found that claret, hock, sauterne, and chablis tend to irritate the cough less than the stronger wines. Champagne should be given where the prostration is great, and it often is useful in aiding expectoration. In cases of laryngeal phthisis where the dysphagia is urgent, it is often advisable to feed the patient by nutritive enemata or suppositories.

Hygiene. — The consumptive patient should inhabit a well-ventilated, well-drained house, built on a dry soil, sand or gravel, sheltered from cold winds and well exposed to the south, not hemmed in by trees, the most suitable for the neighbourhood of the house being of the coniferæ order. The bedroom should be lofty, provided with a fireplace for warmth and outlet ventilation; and unless the cubic space be abundant, 1,500 to 2,000 cubic feet per head, inlets for the supply of fresh air, in the form of Chowne's tubes, should supplement the ordinary indraught of the door and window. Both bedroom and sitting-room should be exposed to the sun's rays, for the vivifying influence of which there is no substitute; and it is well to secure for the patient himself their benefit as long and as often as possible. Even pyrexial cases are the better for being exposed (as is the custom in German hospitals) on couches in open balconies adjoining the wards during the best hours of the day, and thus enjoying the full influence of sunshine and fresh air. The sputum should be received into a vessel containing a disinfectant, to be frequently emptied, or it may be burnt, as is done at the Hospital for Consumption and Diseases of the Chest, Brompton.

Clothing and Exercise. — The under-clothing should be woollen, either flannel or lambswool, or perhaps in summer merino may be allowed, the object being to secure a good non-conductor of changes of the temperature which will, at the same time, absorb cutaneous moisture. The rest of the clothes must be adapted to the season, the invalids, male or female, always bearing in mind their greater liability to catarrh than ordinary persons, and using wraps freely, more especially when driving. The wearing of respirators, though undoubtedly a protection against cold, is not always desirable, as, unless the wire meshes are widely separated, they considerably impede free respiration, and form a kind of muzzle. A woollen scarf passed over the mouth and nose, in the fashion of omnibus drivers, or for ladies a good Shetland veil or 'fleecy cloud,' answers the same purpose without obstructing respiration.

Exercise must depend on the stage of the disease and the strength of the patient. In the first stage, especially when the disease is limited to one lung, and no fever or hæmorrhage is present, active exercise in the form of walking is advisable. Under careful superintendence, certain gymnastic exercises may be of benefit, which, by raising the arms, lift the upper ribs, and increase the size of the thoracic cavity, especially in the upper regions, and thus necessitate a larger inspiration of air; and in time this leads to further development, and even to hypertrophy of the healthy lung. Emphysema may be produced in the diseased lung by this means, which is useful in limiting any further advance of infective tubercular disease.

Riding is excellent for a large number of patients, being intermediate between the active and passive varieties of exercise. Where the disease is more extensive and advanced, only the passive forms of driving and sailing are possible.

4. *Climate.*—The main point to be held in view is to give the consumptive a climate in which he can breathe freely, take abundant outdoor exercise, and experience that amount of stimulating influence which, while it improves his appetite and powers of digestion, does not irritate the mucous membrane of the lungs or increase the cough. The selection is generally difficult, and not only depends on the class of cases, but must be sometimes modified by individual peculiarities. *See* CLIMATE, Treatment of Disease by.

The writer's statistics, founded on 251 consumptives, who passed one or more winters in warm climates out of England, assign the most favourable results to sea-voyages, and the next to Egypt and other dry climates. The Mediterranean basin, including Riviera, Malaga, Algiers, and the islands of this sea, follows next in point of success; while the moist temperate

climates of Pau and Rome give far less good results, and Madeira only slightly surpasses these. The same statistics show the foreign health-stations to be on the whole more successful in prolonging life than the English ones; but we must not forget that the most advanced cases fall to the lot of the latter, on account of the difficulty of travelling; and, on the other hand, a great advantage enjoyed by the home stations is the superiority of the food, which may in some degree compensate for the smaller number of days in which exercise can be taken, and the greater vicissitudes of weather. Of the British Channel health-resorts the more easterly, such as Hastings, Ventnor, and Bournemouth, have afforded more favourable results than Torquay and Penzance. It is impossible in a few sentences to lay down rules for climate-selection, but a few general outlines may be given of the suitability of different groups of agencies.

The British south-coast stations are beneficial in scrofulous phthisis, and in many cases where the appetite is poor, and tendency to catarrh not the prevailing feature. They are beneficial too in cases of chronic limited cavity. In the catarrhal form of phthisis the Canary Islands, Madeira, and the West India Islands, especially the Blue Hills of Jamaica, are advantageous; the combination of warmth with saline influence, and the absence of stimulating qualities, seeming to answer best.

Dry stimulating marine climates, such as the Riviera and Malaga, are recommended in phthisis supervening on inflammatory attacks, and in all cases where it is desirable to combine stimulating influence with a moderate degree of warmth, and decided dryness of atmosphere. Where greater warmth with a little more moisture is required, Algiers, and the islands of Corsica, Sicily, and Corfu will suit better. As better examples of warm dry climates may be instanced those of the Pacific—of Sierra Madre, Coronado Beach, Santa Monica, and Los Angeles.

Where the stimulating influence is undesirable, as in patients of excitable temperament, or irritable gastric mucous membrane, the *very dry inland climates*, like those of Egypt or South Africa, are preferred.

Sea-voyages to South America, Australia, and New Zealand, round the Cape, or the shorter one to the Cape itself, are indicated in cases of hæmorrhagic phthisis, of scrofulous phthisis especially with fistula in ano, of phthisis with emphysema, in cases of limited first or third stage, where the strength is unequal to much exercise, and where the patients have suffered from overwork or close confinement in crowded cities. See SEA-VOYAGES.

High altitudes.—The considerable mass of testimony in favour of this form of climatic treatment for consumption, in Europe, Africa, and North and South America, has rendered it the most popular one of the day. The writer's statistics of 247 consumptives treated in Davos, St. Moritz, Colorado, and the South African highlands show that in unilateral tubercular consolidation more or less extensive improvement occurred in $97\frac{1}{2}$ per cent., and complete arrest of the disease in $66\frac{1}{3}$ per cent., and that even in bilateral cases the percentage of arrest was 40. The results in cavity cases were not so favourable, about 54 per cent. improving and 35 per cent. becoming worse. These results are the most favourable, but it must be remembered that the greater part were achieved in incipient and limited cases after residences varying from months to years.

At present the Andes, the Rocky Mountains, and the Alps, and even the South African highlands, are frequented by consumptives; but the conditions of temperature and altitude manifestly vary greatly, and while the climates of Quito and Santa Fé di Bogota resemble in temperature that of Malaga, the winter extremes of Davos and St. Moritz in the Alps are more nearly akin to those of Canada. The Colorado climate is a very sunny mountain climate, with considerable extremes, but drier than the Swiss. In all these places, however, there exists a distinctly specific influence apart from that of heat and moisture, in the form of diminished barometric pressure, producing rarefaction and diathermancy of the atmosphere, which is shown in the patients residing at high altitudes. The chest becomes expanded, and hypertrophy of the healthy lung-tissue takes place, accompanied by vesicular emphysema around the lesions. Patients with tubercular consolidation of one or both lungs, provided the lesions admit of sufficient lung surface for proper aëration, the powers of the circulation be sufficiently good to allow of exercise, and there be no pyrexia, are the proper cases for this form of climate, and in many of such complete arrest of the disease may perhaps be predicted. These high altitudes are also suited for hæmorrhagic phthisis or phthisis of distinctly hereditary origin, provided it be not too advanced; and they are contra-indicated in (1) old patients, (2) catarrhal and laryngeal phthisis, (3) phthisis with albuminuria, (4) phthisis with double cavities, and wherever the extent of the disease or the condition of the lung places the patient in the category of 'advanced cases.'

C. THEODORE WILLIAMS.

PHYSICAL EDUCATION.—INTRODUCTION.—*Physical education* concerns itself with the fullest development of the body, just as education, in the general sense of the term, has for its object the fullest development of

the manifold qualities of the mind. A child of normal faculties brought up in the midst of a civilised people, and deprived of systematic teaching of any kind, would, when manhood was reached, exhibit a degree of intellectual development which might surprise those who can conceive no mental worth unless it be the product of the pedagogue. An individual thus left to himself would learn much from observation, experience, and example, but the methods of his mind would be clumsy and imperfect, and he would lack those arts whereby knowledge can be economically and systematically acquired and conveniently employed. He would, in fact, remain imperfectly developed, and would have missed the opportunity of making the best of his faculties.

It is precisely the same with the physical development of the body, if it still be assumed that the individual is born among a civilised people. To simply leave a child to his own devices when he is not engaged in school work, is not to provide him with a sound or even an efficient education of the body. It must be borne in mind that the modern child has departed very far from the primitive savage, and that his environment, the claims upon his energies and the trammels of civilisation, no longer render it possible to leave the perfecting of his body solely to 'nature.' It cannot even be said that the physical development of the higher race of savage, when mythological matter is excepted, leaves nothing to be desired.

Physical education, therefore, to be of the highest service, must be precise and systematic, must be graduated and progressive, and must be adapted to the personality of the individual. It must be conducted, indeed, upon precisely the same lines as is the better formulated education of the mind.

Physical education involves exercise and movement. Save by exercise, there is no means of developing any portion of the organism, even provided that the supply of food and of air be sufficient. Exercise means growth, functional vigour, and the maintenance of a high standard of organic life. Undue rest is followed by feebleness and decay. Absolute rest is found only in death.

It is assumed in the present article that exercise is confined within proper limits. The subject of the abuse of physical exercise is dealt with in another article. *See* Exercise.

1. The effect of Exercise upon the Body.—Exercise increases the size of a muscle, the stoutness of its tendon, and the power it can command. The stronger the muscles, the finer and denser are the aponeuroses with which they are connected, and the firmer are the fasciæ which hold them in position. Muscles act upon articulations. The duly exercised joint has a good covering of cartilage, powerful ligaments, and well-developed bony parts. Exercise, moreover, influences the size of the bones upon which the muscles act, renders them stronger and denser, and emphasises their anatomical details.

Exercise induces a more vigorous respiration, and under increased breathing efforts the lung-capacity and the size of the thorax are augmented. It accelerates also the blood-circulation, and the effect of an increased blood-supply upon the size and condition of the tissues concerned is well known.

The secret of the size and proportions of the future man lies buried in the ovum from which the individual is developed. It may be said, indeed, that there are two proportions possible in every human body: first, that which is congenital, inherited, and predetermined; and, secondly, such an increase or modification of these proportions as may be effected by proper exercise.

The child of short and stunted parents will probably also be short and stunted, and remain so in spite of an elaborate physical training.

A young child is a very plastic object, but it cannot quite be moulded as potter's clay; and there are many cases of congenital narrowness of chest and lack of symmetry in limbs which no system of physical education can remove.

The effects of systematised exercise upon the growth and development of the body have been demonstrated by many observers, and have been expressed in the form of actual measurements by Maclaren and others. In the *Report* of the Anthropometric Committee, the measurements of eighty-nine professional and amateur athletes are given, with the following results: 'Their average stature exceeds that of the general population from which they are drawn by 0·68 inch, while their average weight falls short of that standard by 14·5 lb. The ratio of weight to stature is 2·100 lb. in the athlete, 2·323 lb. in the general population, for each inch of stature.

In noting the effects of physical exercises by means of measurement, the most conspicuous attention is drawn to the increase in height and in the circumference of the chest. In young subjects there is strong evidence in support of the belief that systematised exercise may actually increase height. In cases in which the training has been commenced after the growth of the body has ceased, any increase in stature is to be ascribed to a straightening of the spine and an improved carriage.

In considering the general question of increase in chest-girth, care must be taken not to ascribe this improvement—as some are apt to do—entirely to an increase in the capacity of the thoracic cavity. This is probably in all cases of much less effect than muscular development. In measuring

the chest, the tape passes over those very muscles which are prone to the most conspicuous development in those who practise gymnastic exercises, for example, the pectorals and the great muscles passing from the trunk to the upper limb. The effect of proper exercise in augmenting the respiratory capacity to a certain degree is, however, undoubted.

A physical training does something more than merely increase the size of the limbs, and add to the stature. It tends to render all parts of the body symmetrical, and more perfectly proportioned. Of all animals, man is the most subject to variations in proportion and symmetry. Not only do children often grow in a fitful and irregular manner, but they may exhibit unequal developments, one side appearing to be larger than the other. Such deviations, which are distinct from actual deformities, a well-directed system of training will usually correct.

There must needs be a limit to the growth of muscles, and those exercised to too great a degree will, after attaining a certain size, commence to waste.

Moreover, from exercise there result an increase in the contractile force of the muscles, and an improvement in the speedy and complete contraction of their fibres. The muscles of an athlete when in training contract with extraordinary force under the electric current; the muscular sense is developed to its utmost; the perfection of the reflex act is attained; the power of coördination possessed by the individual is augmented; and movements at one time complex and difficult are carried out with ease. In this way the nervous system is saved a great expenditure of force.

One conspicuous feature in muscular training is the increase in the possibilities of automatism, and another remarkable element is the economy of force which results from muscular education. He who has been well trained physically, possesses not only a complete, but an intelligent, use of his muscles. His movements are powerful, are under absolute control, are precise, and capable of the finest and most elaborate adjustment. The art of the athlete consists not in employing the greatest amount of power in effecting a movement, but in carrying out that movement with the least possible expenditure of force.

Not only does a systematic training promote the fullest growth of the body, and help the individual to attain to something approaching a perfect symmetry, but it gives to him an easy and graceful carriage, and a bearing which has about it the mark of vigour and completeness. With suitable exercises, the shuffling and shambling gait disappears, the loutish boy ceases to look loutish, and the gawky girl no longer excites comment, rounded shoulders become square, and bending backs are made straight. The athlete, so far as his body and his personal equation are concerned, has reached the full and perfect stature of a man; and the girl whose physical education has been complete, reaches her point of physical perfection as a woman. It must not be forgotten that the beauty of the body depends upon a fully formed skeleton and perfectly developed muscles, and not upon deposits of fat.

The tissues of the ill-developed are flabby and lacking in elasticity and consistence; those of the well-developed are, on the other hand, firm, resisting, and full of evidence of living. The delicate and sensitive complexion of a young woman whose physical training has been efficient is in conspicuous contrast with the dull lustreless integument of the individual who 'never stirs out of the house.' The skin of the recluse is grey, greasy, and unpleasant-looking. Exercise involves more living in the open air, a freer and deeper respiration, and the coursing of a more vigorous flow of blood through the integuments. In the matter of personal comfort, no greater sense of pure pleasure can illumine the human mind than that which results from perfect health; and such health cannot be attained without a full exercise of the manifold energies of the body. He who takes no exercise remains an imperfect creature—he misses at least one-half of the delights which are available to man during a comparatively short existence, and it is not to him that 'joy cometh in the morning.'

2. **The effect of Exercise upon the Mind.**—Moderate, regular, and systematic exercise, by stimulating the circulation of the body, improves also the circulation of the brain, and is therefore an aid to cerebral movements. By improving the health and physical strength it increases the capability of the individual for mental work, and for the physical strain consequent upon mental concentration. It offers, too, an admirable change of employment, and in this way becomes a valuable means of rest. 'Prescribe fencing, gymnastics with apparatus, and lessons in a riding school,' writes Dr. Lagrange, 'to all those idle persons whose brain languishes for want of work. The effort of will and the work of coördination which these exercises demand will give a salutary stimulus to the torpid cerebral cells. But for a child overworked at school, for a person whose nerve-centres are congested owing to persistent mental effort in preparing for an examination, we must prescribe walks or rides, the easily learnt exercise of rowing, and, failing better, the old game of leap-frog and prisoner's base, running games—anything, in fact, rather than difficult exercises and acrobatic gymnastics.'

An excessive and absorbing indulgence in physical exercises is undoubtedly bad, and it

may be that in some public schools too great significance is attached to mere athleticism. The all-engrossing pursuit of athletics tends to make the individual too much of an animal, and to afford neither time, opportunity, nor suitable conditions for the development of his brain. Still, on the other hand, in these days of cramming and intense competition, many a man can base his success in life upon physical health before all things; and there are not a few who have attained to eminence among their fellows who have to thank Providence for the tardily recognised blessings of an idle youth.

The systematic and properly arranged pursuit of physical exercise tends to develop certain admirable qualities, and notably those which are so much prized among Englishmen, and which are well designated as 'manly.' These qualities are brought out in those who are enthusiasts in outdoor sports and games. The football player has done more than merely develop his muscles; and the man who has rowed in his college eight has learnt something beyond the mysteries of the sliding-seat. Such lads and men have learnt in a school where the principles of pluck, courage, endurance, and self-reliance are acquired. They will have learnt to be ready, to be quick of eye and hand, and prompt in judgment. They will have appreciated the value of discipline and of self-control. They will have felt the inspiration of the chivalry of days gone by, and have experienced the influences of good fellowship and loyal comradeship. They will probably have learnt what it is to be patient, to be fair, to be unselfish, and to be true. The following utterances by the head-master of a large public school in England are worthy of note: 'The worst boys intellectually, physically, and morally are the loafers.' 'The boys who work hard and play hard do not ape the vices of men, and are free from the insidious evils that often fasten on unoccupied boyhood' (*Cathcart's Health Lectures*: Edinburgh, 1884).

3. The Elements of Physical Education.

(*a*) *The exercises should be adapted to meet the needs of each individual case.*—The object of a proper physical education is to develop health and not mere strength, to bring the body to its highest degree of perfection, and not to convert children and youths into gymnasts and acrobats. Its principal purpose is to best fit the individual for the duties and work of life, and not to elicit proficiency in mere feats of skill and adroitness.

It must not be forgotten, moreover, that individuals vary greatly in the quality of their physical powers, and in their capacity for muscular exercise. It is just as impossible to form a great mass of children into one gymnastic class as it is to place those children in one school standard under one teacher. Neither age, height, size, nor sex affords sure means of classifying children, so far as the needs of a proper physical education are concerned. Each individual must be considered upon his or her own especial merits, and there is no method of physical training which is universal or all-sufficing, and adapted for all sorts and conditions of human beings. The sending of a child to a gymnasium, or the placing of it under the care of a drill-sergeant, is as crude a procedure as the conducting of a child within the walls of the first school met with, and leaving it there with the impression that it will somehow be educated. Physical education requires as much care as does mental education, and calls for as much subdivision both in the teaching and in the taught. Before planning out a course of instruction, a child's physical condition should be inquired into with as much care as is exercised in examining an adult for life insurance.

(*b*) *The exercises should be carefully devised, systematically arranged, and suitably graduated.*—The exercises should be planned upon a definite system, should be suited for the individual, and should aim at the equal employment of all the muscles, and not at the developments of a few. The work in an ordinary gymnasium tends to throw strain mainly upon the upper extremities, while most of the outdoor games tend to develop the lower limbs. No great good can be obtained from tedious drilling and purposeless marching, and the time devoted to physical training should never be so absorbing as to allow no leisure for games and other pleasant forms of recreation. It is desirable that the lessons should be as varied and as interesting as possible, and that reasonable opportunity be given for competition, and the encouragement of those who are specially fitted to excel. In every instance violent intermittent exercises should be forbidden, and the performance of feats of strength should never come within the scope of the education scheme.

(*c*) *The exercises should be carried out under proper guidance, and with suitable and efficient apparatus.*

(*d*) *The time for the exercises should be carefully selected.*—Violent exercise after a full meal is obviously bad, and a course of physical instruction should not be carried out in the case of children who are tired from a long day's attendance in school, or who are feeble from want of food.

In the matter of schools, it is well that the period for physical training should be interpolated among the hours devoted to ordinary school work. The Rev. Dr. Warre, of Eton, advises that a schoolboy's day should be disposed of as follows: Rest, ten hours; work, seven hours; meals and play, seven hours.

So far as adults are concerned, the taking

of violent exercise in the evening, after a long and arduous day's work, is often injurious in its result. There is no better time for such individuals than the early morning.

(*e*) *Exercises, so far as is possible, should be taken in the open air, or in a large and well-ventilated room, and the subjects of the instruction should be properly clad.*—The atmosphere of many gymnasia and fencing saloons is, especially in the winter-time, close and unwholesome. The garments worn should be light, loose, and always made of wool.

4. The Selection of Exercises according to Individual Needs.

Children.—The physical training of the child should be commenced early, should be made as interesting as possible, and be represented in the main by what may be termed scientific romping.

The exercises should be given, whenever possible, in classes.

The set exercises should not be too formal, and never be too long; and in no instance should they be allowed to take the place of the ordinary outdoor games of children.

Games which involve shouting should be encouraged, and a very prominent position given to running, skipping, games with balls, and jumping.

The most rudimentary of all games, 'touch,' is one of the most excellent. The upper limbs may be encouraged by such amusements as battledore-and-shuttlecock, and the lower by such a game as hop-scotch.

The set exercises should take the form of what are known as Swedish gymnastics, the vocal march, musical drill, and the class exercises with dumb-bell and bar-bell.

Children should avoid exercises of strength; and, in the main, exercises of speed. There is little need for especial gymnastic apparatus. Those best suited for children are the climbing-rope, the inclined ladder, the vaulting-horse, and the parallel bars. The detailed exercises are described in the writer's work on *Physical Education* (London: 1892).

Girls and Women.—The physical condition of a large proportion of the girls and women in this country is quite deplorable, especially among the middle and upper classes. It is apt to be ascribed not to a totally neglected education, but to the belief that growing girls are always awkward, uncouth, and weedy. This belief is not well founded.

The girl is too often encouraged to be dull, to be prim, to be subdued, to suppress the outbursts of pure animal spirits. She is more or less under the curse of that detestable adjective, 'lady-like.' She spends hours in an ill-ventilated schoolroom and upon a piano-stool, and the rest of her time is occupied in eating and sleeping, in preparing lessons, in stooping over needlework, and in taking formal walks with the governess.

A good digestion and vigorous lungs are more useful to a woman in the battle of life than a knowledge of advanced mathematics; and sturdy limbs and strong hands are of more value to the mother of children than even decimal fractions and a familiarity with irregular verbs.

Younger girls may pursue the exercises named in dealing with the education of children. Those who are a little older have an infinite variety of healthy pursuits at their service—running, skipping, outdoor games, riding, skating, swimming, cricket, games with balls, archery, tennis, and certain exercises in the gymnasium. They should practise also such movements as develop the abdominal muscles, and should never neglect rowing.

Fencing in moderation is good; a tendency to flat feet and weak ankles may be met by such games as hop-scotch, by step-dancing, and the hornpipe.

Cycling may as well be avoided, and jumping is probably not advisable for girls who have passed the period of puberty.

For women, such exercises as have just been detailed are open, with the obvious modifications which their age and dispositions suggest.

Lads.—Lads between fourteen and eighteen have almost every form of exercise and physical recreation open to them. They should avoid feats of strength, paper-chases, and exercises of extreme speed, such as sprint-running, which are apt to cause strain of the heart as well as other kinds of injury.

Adults.—Adults between eighteen and twenty-five have the whole of the joys of the athletic world open to them, and if a man keep in training and in practice his period of athletic life may be extended to thirty. The middle-aged and elderly must anticipate a progressive curtailment of their more active pursuits. There remain, however, walking, and all the milder forms of outdoor exercise —riding, rowing, skating, cycling, golfing, and the use of the simpler gymnastic apparatus. After thirty, few men are capable of undertaking exercises of speed without actual risk.

FREDERICK TREVES.

PHYSICAL EXAMINATION. — The object of a physical examination is to ascertain the precise seat, limits, and characters of those evidences of disease which are recognisable by our senses, and which are called physical signs. In making such an examination we bring to bear all our senses, with whatever instrumental aids may be available, to detect the signs of disease. In the present article a description will be given of the physical examination of—(1) the Patient Generally; (2) the Cerebro-spinal System; (3) the Respiratory System; (4) the

Organs of Circulation; (5) the Mediastinum; and (6) the Abdomen.

1. **General Survey.**—Our attention will first of all be naturally attracted to the *physiognomy* of the patient, that is, to his general appearance and build. We note his apparent *height* and *weight*, and, if possible, correct our observation by scale and measure. We observe the *state of nutrition*, firmness or laxness of muscle, corpulence, thinness, emaciation—atrophy of any particular muscle or group of muscles. The *complexion* of the patient is to be remarked, whether clear, sallow, dark, fair, jaundiced, or pigmented: also lividity or pallor of surface and mucous membranes. The *apparent age* as contrasted with actual years of the patient; elasticity of features, condition of hair, presence of arcus, &c. The *symmetry* and *play of features*, the expression whether of vivacity, despondency, suffering, anxiety, paralysis, or hysteria. *See* PHYSIOGNOMY.

Whilst making these preliminary observations, a general outline of the history of the patient and of his present illness will have been elicited.

The *pulse* should next be noted (*see* PULSE). We may, in important cases, extend our inquiries or record our observations by means of the sphygmograph. *See* SPHYGMOGRAPH.

The *respiration* of the patient requires attention as regards rapidity; mechanism, that is, whether abdominal or thoracic in normal proportion; rhythm, regular or irregular, easy or laboured; and freedom or otherwise from pain. The action of the nares, and any recession or otherwise of soft parts during respiration, should be especially observed.

In health and under physiological conditions of age, exercise, emotion, &c., there is a tolerably constant ratio between the respiration and pulse-rate, namely, one respiration to from three to four pulse-beats. In disease this ratio is often much altered. The average respiration-rate in a healthy adult is from 17 to 20 per minute, in the infant about 40 per minute, between one and five years about 26 per minute. In old age the respirations are very slightly accelerated: in children they are quick and often irregular, being momentarily suspended by anything that excites their wonder or close attention.

The *odour of the breath* may attract attention. It may under morbid conditions be fœtid, urinous, 'mercurial,' alcoholic, or gangrenous. *See* BREATH, THE.

The condition of the *skin*, whether dry or hot, moist or sweating, and the presence or absence of any eruption, scars, ulcers, or pigmentation, will be duly noted. The presence of *pyrexia* will be exactly ascertained by the use of the clinical thermometer, an instrument which ranks with the stethoscope in value; but the employment of the thermometer does not exclude the necessity of testing the condition of the surface by the hand, whereby we observe the resultant, so to speak, of the bodily heat, tempered it may be by evaporation, or exaggerated by undue dryness in exposed parts. Probably the use of the surface thermometer, in combination with the ordinary clinical instrument, would more exactly give us this information, upon which important therapeutical indications rest; but the hand of the skilled observer fully suffices for the purpose. The surface thermometer is of value in estimating localised elevations of temperature; for example, over the site of an empyema, in peritonitis, and in connexion with certain nerve-lesions. *See* THERMOMETER, CLINICAL.

The condition of the *finger-ends*—clubbing, lividity—must be observed. Important information as to the previous acute illnesses within the past six months can be obtained by inspecting the nails, a transverse furrow marking the period of defective or arrested nutrition during such illness.

The condition of the *teeth* may indicate previous illness or syphilitic inheritance.

The state of the *eyes*, and especially any irregularity of the *pupils*, requires attention.

The condition of the *tongue* and *gums* furnishes us with valuable information.

The careful superficial inspection of the patient in the manner above sketched will perhaps at once lead to a more minute examination of some one organ or system of organs as the probable seat of disease; and having thus far succeeded in locating the disease, the other organs and functions of the body will of course come under review, but the physician will be more especially inquisitive with regard to such organs or functions as may be in sympathy with those in which disease has been detected.

It may be, however, that on careful examination we fail to find any organic lesion to account for the symptoms present, and for signs of wasting, pyrexia, &c., which notify the illness of the patient. We may then—but not till then—refer the case to one of those blood-conditions which for a time run their course without manifesting any definite lesion.

Again, it may be that certain signs of general illness, and especially pyrexia and wasting, cannot be accounted for sufficiently by the amount of disease discovered. Here we must suspect that the lesion we have ascertained is but an expression of a more general state.

Having made these remarks—relating to orderly measures of inquiry, without a due regard to which no physician or surgeon, however skilful in any one department, can fail to commit the errors of the narrowest specialist—we will proceed to consider the physical examination of those regions of the body, especially the chest and abdomen, in

which objective signs can be accurately observed.

2. **Cerebro-spinal System, Physical Examination of.**—The objective phenomena of disease affecting the nervous system are often very obscure, and it is the more important that they should be sought for in a methodical manner.

(*a*) The Head.—The head should be examined as to size, shape, condition of fontanelles, the presence of wounds, tumours, or depressions.

The *size* of the head varies greatly in different persons and individuals, without any seemingly corresponding variation in the condition of the brain. It is very difficult to say whether enlargement of head is due to thickening of the skull or enlargement of its contents. In rickets and in hydrocephalus the head is relatively large; in idiocy relatively small.

The *shape* of the head is of more importance than the size. We may recall the long head, with square, high forehead, of rickets; the broad, vaulted skull, with shallow orbits and prominent eyes, of hydrocephalus.

The condition of the anterior fontanelle must be carefully observed in all cases of children with cerebral symptoms—it should be neither tense nor depressed.

The detection of *local changes*, such as thickenings, tumours, scars, or depressions over the skull, will throw much light upon a case presenting cerebral symptoms.

(*b*) The Spinal Column.—The spinal column must be carefully examined for undue prominence or depression of spinous processes, or other tumours, and for lateral or antero-posterior curvature. Kneading and percussion should be employed over each spinous process to elicit any tenderness. The fingers should be passed firmly along the spinal groove on either side to ascertain if there be any painful point, and much care must be taken not to confound such pain (commonly neuralgic) with true spinal tenderness. The application of the hot sponge, or ice-bag, successively to different parts of the spine is a means of eliciting valuable signs of disease.

In all cases of suspected spinal or cerebral disease the *superficial* and *deep reflex actions* should be tested, as affording important indications respecting the integrity of successive portions of the cord, and the condition of the parts above. *See* Spinal Cord, Diseases of.

By the *ophthalmoscope* an example of the cerebral circulation may be observed in the retina, and the condition of vessels noted. Certain lesions of the optic disc correspond also with deeper and more widespread nervous disease (*see* Ophthalmoscope in Medicine). By the use of *graduated compasses* the sensibility of the peripheral nerves may be estimated. *Electricity* enables us to ascertain the irritability of voluntary muscles; and by the *dynamometer* we may compare muscular power on the two sides. *See* Electricity in Medicine; and Dynamometer.

Further details respecting the diseases of the nervous system, and the methods for their diagnosis, will be found under appropriate headings.

3. **Respiratory System, Physical Examination of.**—The respiratory system includes the respiratory tract and lungs.

(A) Larynx.—The condition of the larynx and trachea is examined into by listening to the voice, whether husky, altered in tone, or suppressed. Any tenderness or external deformity is ascertained by careful palpation.

By means of the laryngoscope the condition of the epiglottis, larynx, and trachea can be thoroughly explored. *See* Laryngoscope; and Larynx, Diseases of.

(B) Chest.—In making an examination of the chest, the physician should follow a methodical routine of **inspection, palpation, percussion, and auscultation.**

(1) **Inspection.**—The *general shape* and *build* of the chest is observed—whether it be the broad, well-formed chest of robust health; or the small, narrow, long chest, with antero-posterior and lateral diameters diminished, costal angle narrow, and ribs oblique and approximated—adapted to small lungs. Or the thorax may be unduly expanded, with wide intercostal spaces, straightened ribs, widened costal angle, and deep antero-posterior diameter, to accommodate large lungs. Again, the thorax may be distorted by various kinds of spinal curvature, or as the result of rickets, or from external pressure, as in the depressed lower sternum of shoemakers (*see* Deformities of the Chest). Lastly, there may be *local* flattenings or bulgings.

The *movements* of the chest are of great importance in diagnosis. We estimate the freedom or otherwise with which air enters the chest during inspiration by the equable expansion of its several parts, or by the immobility or recession of any portion the entry of air into which is retarded or impeded; and this can be accurately done by means of the pneumograph. In cases of general obstruction to entry of air, whether by impediment at the main air-passage or in its entire distribution, there is universal recession of all the soft parts—the supraclavicular region sinks downwards, the hypochondria recede, and the intercostal spaces deepen during the effort to expand the chest against atmospheric pressure. On the other hand, when the difficulty of expansion, whether from intrinsic disease or obstruction of passages, is restricted to one side of the chest or to a portion of one lung, the restrained expansion during inspiration is limited to that portion. Thus from inspection alone we may often form a shrewd

guess as to the seat and even the nature of the disease present.

In estimating local alteration of shape, the eye is perhaps more useful than any instrument of measure. *Calipers* of various patterns may be used for taking diameters in different directions. But for *recording* differences of shape on the two sides the *cyrtometer* is very useful. This instrument was originally introduced by M. Woillez, and consisted of two halves of a jointed whalebone measure, connected by a hinge, which could be adapted accurately to the shape of the chest, and after removal the various curves on the two sides could be traced on paper. The cyrtometers now most in use are made of soft metal, two sufficiently long pieces of which are connected by an indiarubber joint or hinge.

Double tape-measures are also used for ascertaining the circumference on the two sides, and by their means the relative expansion during respiration on the two sides can be compared. Various forms of stethometer have been designed for the same purpose. *See* Stethometer.

The *vital capacity* of the lungs may be very accurately estimated by means of the spirometer. *See* Spirometer.

(2) **Palpation.**—Palpation is employed in aid of both inspection and percussion.

(*a*) During preliminary inspection of the chest the *position of the heart's apex-beat* should be invariably, and as a matter of habit, ascertained, and any deviation from its normal seat, namely, the fifth intercostal space one inch to the sternal side of the left nipple line, should be noted.

(*b*) Any local bulging or tumour will naturally be *manipulated* to ascertain its relation with bone, or soft structure, whether it be solid or soft, fluctuating or pulsatile.

(*c*) In connexion with percussion, the trained observer will note differences of *resistance*, as well as of sound, over diseased areas.

(*d*) Increase or diminution of *vocal vibration* or *fremitus* will be noted over any spot of altered resonance, by applying the hand and making the patient utter some resonant words, such as 'ninety-nine.'

Vocal fremitus is *increased* by consolidation of lung (unless the bronchus be obstructed by growth or otherwise); *diminished* by much thickening of the pleura, by obstruction to the main bronchus, or by air in the pleura; *annulled* by fluid in the pleura. N.B.—In many cases of fluid in the pleura some vibrations are felt, probably communicated from above. The loudness or feebleness of the voice must of course be taken into account in estimating fremitus, and corresponding parts on the two sides should always be compared.

Loud, coarse, bronchial *râles* may cause the chest-walls perceptibly to vibrate, producing *rhonchal fremitus*. Pleuritic friction may likewise be perceptible to the hand applied—*friction fremitus*. In cases of effusion into the pleural cavity, or in hydatid cysts near the surface, *fluctuation* may be elicited on palpation.

(3) **Percussion.**—Percussion is the method of examination by which we detect the various degrees of resonance of different parts of the chest, depending upon the relative amount of air and solid structure.

It is best to use the fingers for percussing, one finger of the left hand being placed firmly over the point to be percussed, and struck with one or two of the fingers of the right hand, semi-flexed, so that the tips of the fingers fall vertically upon the pleximeter finger. Percussion should be made from the wrist, not from the elbow; the stroke should, as a rule, be light, and always perfectly even on the two sides; sometimes a heavier stroke may be needed, but, as a rule, far more information is obtained from light than from heavy percussion. In comparing the percussion note over the two sides of the chest, points exactly corresponding must be taken, and the pleximeter finger must be placed in a corresponding position; for example, it must not be placed parallel with the ribs on one side and across them on the other.

The sense of touch is very valuable in percussion in estimating *resistance* of the part struck. Dulness, and particularly the hardness and want of resilience over thickened adherent pleura, may thus be readily *felt* by the pleximeter finger during percussion. This sense of touch should be carefully cultivated, and its deprivation is a great disadvantage in the use of the artificial pleximeters and percussors first introduced by Piorry, although possibly these may be useful for demonstration to a class. The observer should not be content with comparing corresponding points on the two sides of the chest from above downwards, but he should invariably trace any dulness or resonance from either side across the sternum to ascertain the limits of resonance or dulness in this direction. From neglect of this, important information is often missed. The height to which the pulmonary note extends above the clavicle on the two sides should be compared.

Regions of the chest.—For convenience in describing the distribution of signs, both of percussion and auscultation, it is customary to divide the chest into regions. The names employed to distinguish these regions sufficiently define their limits, namely, the supra-clavicular, clavicular, infra- or sub-clavicular, mammary, infra-mammary regions on each side in front; the superior and inferior axillary regions; the supra-spinous, infra-spinous, inter-scapular, and infra-scapular regions on each side posteriorly.

(*a*) Normal Percussion Signs.—There is a certain standard degree of resonance over the lungs, only to be duly estimated by expe-

rience, which is known as *normal pulmonary resonance.* In certain regions of the chest the pulmonary resonance is naturally lessened or replaced by dulness. Pulmonary resonance should commence 1½ inch above the level of the clavicle. In the clavicular and sub-clavicular regions, on firm percussion, the note should be even on the two sides, as low as the third rib. Below this level, on the *right* side, we still obtain full resonance until we arrive at the fourth space, where in the mammary line the note becomes slightly raised and shortened, becoming dull in the fifth space and downwards to the margin of the cartilages. On very light percussion the pulmonary resonance may be obtained half a space lower; and at least an inch to two inches difference in level may be obtained between the extreme limits of deep expiration and inspiration. In the lateral (axillary) region the limit of percussion-resonance reaches about an interspace lower. At the sternal margin it is a little higher, from the encroachment of the right side of the heart upon the inferior angle of the lung. Roughly, and for clinical purposes, a line drawn outwards from the base of the xiphoid cartilage may be said to define the upper border of the liver-dulness.

On the *left* side, in the line midway between the sternum and nipple, we already, at the third cartilage, obtain elevation of pitch and shortening of the percussion note; and at the fourth space dulness, from the underlying heart. Between this (mid-sterno-nipple) line and the sternum, and bounded above by the fourth cartilage and below by the level of the apex-beat, is the normal area of superficial cardiac dulness. In the nipple line at the corresponding levels[1] some deadening of percussion note may be obtained, but pulmonary resonance is otherwise clear to the sixth rib; in the lateral axillary region to the seventh. Below the sixth rib in front, and the seventh laterally, stomach resonance is obtained.

Over the *sternum*, percussion is naturally somewhat wooden and resisting, within degrees varying with the condition of the bones. The first piece of the sternum is normally somewhat less resonant than the next two pieces, but it should be, on firm percussion, by no means dull. Below the level of the fourth cartilages the heart and liver cause the note to be dull, although even here a certain degree of resonance is in health communicated from the adjacent right lung.

In the *posterior* regions of the chest the degrees of resonance are almost entirely in accordance with the thickness and character of superjacent tissues. Thus in the scapular and inter-scapular regions increased force of percussion is necessary to elicit pulmonary resonance, whilst in the lateral and infra-scapular region the percussion note is full and low-pitched. On the right side this resonance is replaced by dulness below the tenth rib, and deep percussion will elicit a certain impairment of resonance as high as the ninth rib, in the mid-scapular line. On the left side resonance should be good to the extreme base, except that in the posterior axillary line a small and restricted area of dulness may be sometimes made out, corresponding with the position of the spleen.

(*b*) Morbid Percussion Signs.—Modifications in the distribution of percussion resonance over the chest may be produced either by general or by local causes.

General causes. — Pulmonary vesicular emphysema, by enlarging the lungs and extending their boundaries, causes encroachment of pulmonary resonance over those regions—the præcordial, right infra-mammary, sternal, and right inferior basic—which are normally dull. In congenital smallness of lungs the boundaries of pulmonary resonance are somewhat retracted, so that liver-dulness in front and behind is slightly higher, and heart-dulness more extensive.

Local causes.—One class of these are encroachments of other organs. Enlargement of the heart will cause increased area of præcordial dulness upwards and to the left, or upwards and to the right, according as the left or right side of the heart is most affected. Effusion into the pericardium will cause similar dulness, extending upwards towards the manubrium sterni, and to the right beyond the sternum. Aneurysmal tumours in connexion with the heart or great vessels, give rise to dulness, chiefly in the neighbourhood of the sternum above the fourth cartilage, or in one or other inter-scapular region. Enlargement of the liver and spleen will cause them to encroach upon the pulmonary resonance. Effusion into the peritoneum, if extensive, will cause displacement upwards of the abdominal organs and diaphragm, encroaching upon the lower area of pulmonary resonance, and even causing collapse of the lower portion of the lungs, thus giving rise to dulness.

Effusion of fluid into the pleura will give rise to absolute dulness to the level to which the effusion extends upwards. The upper boundary of this dulness, if the lungs be sound, varies slightly with the position of the patient. In order, however, accurately to define the upper margin of dulness from fluid effusion the lightest possible percussion must be employed. In any case of considerable effusion into the pleura the dulness encroaches upon the median line, and towards the opposite side. See Pleura, Diseases of.

[1] By employing the terms 'lines' and 'levels' to mean the vertical lines and horizontal levels, in connexion with definite anatomical points, *e.g.* mid-scapular, nipple lines, nipple-, second-, third-, fourth-, &c., rib levels, any portion of the chest-surface may be accurately defined.

The chief kinds of morbid percussion signs will now be discussed.

Dulness, hardness, flatness.—These terms are by no means synonymous with regard to percussion sounds. *Dulness* varies infinitely in degree. Thus over a pleuritic effusion the tonelessness is absolute; and to this degree of completeness of dulness the term *flatness* of percussion note is sometimes applied. There are but a few other chest-conditions in which such absolute dulness is obtained; for example, extensive pericardial effusions, hydatid tumours, extensive malignant growths invading the lungs and infiltrating the bronchi. In inflammatory consolidation of the lung there is always a certain degree of wooden tone in the percussion note. In cases of scattered patches, or nodules, of consolidation in the lungs, with air-containing tissue around, the dulness may be only very slight, amounting to a mere shortening of the note with elevation of pitch. In estimating the slight shades of dulness elevation of pitch is the first point to arrest the attention. *Hardness* of percussion, always more or less appreciable with dulness, is associated especially with consolidations of lung overlaid by thickened adherent pleura.

Skodaic resonance.—In all cases of considerable effusion of fluid into the pleura, in which the lung is not completely collapsed, a peculiar high-pitched tympanitic resonance is found at the sterno-clavicular region on the same side. This resonance, called Skodaic resonance, is a very characteristic sign, and has been attributed to relaxation of lung still in contact with the chest-wall. As the effusion advances to completely fill the chest, this resonance becomes replaced by dulness.

When effusion of fluid follows upon pneumothorax, the lung, unless held above by strong adhesions, is already completely collapsed; and above the level of the dulness caused by fluid there is a tympanitic note, caused by free air in the pleura. In this case the level of the fluid in the pleura shifts with every change in the position of the patient.

Whether the effusion be of serum, pus, or blood, the percussion signs are the same.

Wooden percussion note is obtained by percussing over thickened pleura with some air-containing tissue beneath. The sense of resistance is marked, the pitch high, and the duration of sound short. This degree of dulness, with increased resistance, is commonly present below the clavicle in cases of phthisis, with thickened pleura, and perhaps small, empty cavities, bounded by hardened lung-tissue.

Amphoric or *tubular percussion* is the sound elicited by percussing over a superficial empty cavity, connected by adhesions to the chest-wall. The pitch varies with the size of the cavity, but is always somewhat high. The sound can be exactly imitated by percussing the cheek drawn tensely over the teeth, with the mouth slightly open.

Cracked-metal sound, or *bruit de pot fêlé*, is obtained by sharp percussion over a cavity such as the above. Sudden displacement of air in the cavity will cause the sound, which somewhat resembles that produced by placing the two hands hollowed in apposition, and striking upon the knee. A little secretion in the cavity will facilitate the production of the sound. This physical state may often be appreciated by the touch before the sound can be heard. It is of little clinical value.

Bell sound is elicited by combined percussion and auscultation, and *when present* is characteristic of a very large thin-walled cavity in immediate contact with the thoracic wall, and is most generally significant of pneumothorax. The stethoscope must be applied over the resonant part of the chest, and at another point within the same area a piece of metal, such as a coin, laid upon the chest, must be smartly struck with a second piece of metal. The auscultator hears a sound of a clear bell-like character within the chest, which is of quite a different quality from that produced by the mere contact of metals. It is essential for the production of this sign that the stethoscope and the struck metal be both within the area of chest-surface corresponding with the air-containing sac of the pleura. If, for instance, either be placed over a point below the level of any fluid effusion present the sound will be lost, to be recovered on altering the position of the patient so as to displace the fluid. By means of this sign, the limits of a pneumothorax may be accurately defined.

Hydatid fremitus is a vibratile sensation, sometimes to be felt on smart percussion over an hydatid effusion. In cases of pyopneumothorax a similar sensation may sometimes be felt, on percussing at the exact level of the surface of the effused fluid.

(4) **Auscultation.**—Auscultation simply means the act of listening; but the art of auscultation implies a great deal more than this, namely, the appreciation of the healthy or morbid conditions which produce the sounds heard on applying the ear to the chest or to other parts. If the ear of the observer be directly applied to the chest or part under observation, auscultation is said to be *immediate*. If some substance or instrument be used as a medium between the ear and the part under observation, *mediate* auscultation is said to be practised. Such an instrument is named a stethoscope. *See* Stethoscope.

(*a*) Normal Respiratory Sounds.—If the stethoscope be applied over the trachea of a healthy person, tubular blowing, or bronchial respiration, is heard—that is, a sound as of air blown to and fro through a tube, and with moderate velocity; the mechanism of the sound being the entrance and outflow of

air-currents through the narrowed glottic aperture of the trachea, producing sonorous vibrations within the tube below. As the stethoscope is passed downwards to the first piece of the sternum, the same sound is still heard, but more distant and muffled. In the upper inter-scapular region, where the great divisions of the bronchi are comparatively superficial, the tracheal sounds may still be indistinctly recognised; but below and aside from these points these sounds are normally obscured by the vesicular pulmonary sounds, into the production of which they, however, necessarily enter.

The *pulmonary vesicular breath-sound* is produced by the friction of air entering the air-sacs from the minute bronchioles, and it is supplemented by the conduction of what remains of the glottic breath-sound, now infinitely subdivided. During calm breathing the sound accompanying *inspiration* should be soft and breezy, giving the idea of innumerable similar and associated sounds. In intensity the sound is uniform from commencement to near the end, when it fades without perceptible interval into the expiratory sound. The *expiratory* sound commences at the moment inspiration ceases, being continuous with the inspiratory sound, but it rapidly fades in intensity, ceasing to be audible after the first one-fifth or one-third of the expiratory *act*. Of the time occupied between the commencement of one inspiration and that of the next, the inspiratory *act* occupies nearly one-half ($\frac{5}{11}$ths); the expiratory act occupies the remainder, with the exception of a very brief interval of pause, between the end of expiration and the commencement of the next inspiration. It may here be observed that when the 'expiration' is said to be *prolonged*, it is meant that the expiratory *sound* is audible through a longer period of the act than natural.

If the respiration be hurried and forced, the inspiratory sound is coarser and louder, and the expiration more audible, these sounds approximating to the *puerile* breathing which is normal to young children.

In health the vesicular breath-sound should be about equally well heard over the front and back of the chest, allowance being made for additional thickness of covering over certain regions.

(*b*) Morbid Respiratory Sounds.—*Puerile, compensatory*, or *supplementary breathing* is characterised by increased loudness of vesicular breath-sound, with some prolongation of expiration. Besides being audible over the chest generally in healthy young children, this exaggerated breath-sound may be heard over certain parts of the chest in persons who have some other part disabled or diseased. Thus, with effusion of fluid into one pleura, the respiratory sounds over the opposite lung are exaggerated or puerile. If one apex be diseased, the breath-sound at the other apex is exaggerated. This increased breath-sound to make up for deficient function elsewhere is called *compensatory* or *supplementary breathing.*

The breath-sound may be *enfeebled* over the whole chest, as in cases of emphysema or thoracic muscular debility. Localised enfeeblement of breath-sound may be due to several causes—(1) local emphysema; (2) adherent and thickened pleura, as after old pleurisy at the base; (3) blocking of the alveoli by catarrhal products—common in commencing phthisis at one apex; (4) closure of bronchial tubes by plugs of mucus, or from spasm. If the rest of the lungs be free, this local enfeeblement is made up for by compensatory breathing on the opposite side, or in other parts of the same lung.

Suppressed breath-sound signifies removal of lung from the surface by effusion of air or of fluid into the pleura, or occlusion of a main bronchus by compression or morbid growth.

Wavy and *jerking* respiration are terms characterising a kind of respiration in which the inspiration is either partially or completely interrupted several times. The expiration is rarely thus affected. Waviness of respiration may be due—(1) to an irregular action of the inspiratory muscles, common in nervous people; (2) to cardiac impulse, in which case these interruptions are rhythmic with the heart's pulsation; (3) unequally distributed impairment of the lung-elasticity, for example, in early tubercle-deposits. Dr. Walshe considered that pleuritic adhesions may have the same effect. It will be seen then that waviness of breath-sound is very commonly independent of any organic change, and requires other signs to render it of any value in diagnosis. Jerking respiration or interrupted breath-sound is more commonly due to organic lesions of the third kind mentioned.

Cogged breath-sound is a somewhat clumsy term applied to a form of interrupted respiration in which the interruptions are very even, three or four to each inspiration. Much importance is attached to the sign by some authors. It appears to be due to obstruction in the smallest bronchioles, either by dryish secretion or small nodules of tubercle, requiring some accumulation of inspiratory force to overcome it. The sounds commonly give place to a bubbling *râle*.

Harsh respiration with prolongation of expiration implies a want of vesicularity in the sound. Whilst vesicular breath-sound has been compared to the sound produced by the breeze passing through leaf-laden trees, harsh breathing, on the other hand, resembles a similar breeze traversing their naked branch-tops. Some prolongation of the expiratory sound is inseparable from harshness of breath-sound. Harshness of breath-sound by no means implies increased loudness—rather the contrary. Enfeebled

respiratory murmur is commonly harsh—always so when due to alveolar obstruction. The meaning of harshness of breath-sound is simply commencing consolidation; it goes with incipient dulness, and is one of the earliest signs of apex-disease in consumption. There can be little doubt that its real mechanism depends upon the extinction of the vesicular part of the normal breath-sound, and the better conduction of the glottic sounds, which at peripheral parts of the lung are usually muffled and obscured by the vesicular sounds. The prolongation of the expiration is very characteristic of this early alteration of the respiratory sounds; and it may here be observed, in passing, *with regard to morbid breath-sounds, that the expiration is the most important part of the respiratory act to attend to in auscultation.*

Divided respiration, usually described as a separate evidence of disease, is really an inseparable factor of harshness of respiration. Instead of the two component sounds, inspiration and expiration, fading imperceptibly into one another, they are more or less distinctly separate, the more so as the more typical bronchial type of breathing is acquired. Deficiency of elasticity is the cause to which the division is usually ascribed; it is, however, a significant feature of glottic breathing.

Bronchial respiration is most typically heard over simple lung-consolidation, as pneumonia at the base or apex. Skoda well describes the sound as acoustically identical with that produced by placing the mouth in the position to pronounce the guttural *ch* (as in *ch*oir or *ch*ristian), and drawing the breath to and fro. The inspiratory and expiratory sounds are about equal in length, nearly identical in pitch, and distinctly divided from one another. The sound varies in intensity and definition, from the most intense *tubular* or *tracheal* breath-sound, to the lower-pitched and more diffuse *blowing respiration* (*diffused bronchial breathing*). Besides hepatisation of lung, this form of respiratory sound may be produced by other condensations of lung, for example, from pressure, or by tumours extending from the neighbourhood of a large bronchus to the surface, such as enlarged bronchial glands, mediastinal growths, and aneurysmal tumours. The more diffused blowing sounds are due to less complete consolidation. It is essential that the bronchi be patent, in order that bronchial respiration may be heard; thus, in cases of cancerous growth invading a lung from its root and occluding the bronchi, no respiration is audible. As regards mechanism, however, it can scarcely be maintained that the sound is produced by the passage to and fro of the air in the bronchi of the consolidated lung; for (1) at the period when bronchial breathing is most distinct, the lung is immovably fixed by oxudation; (2) the play of the chest-wall on the affected side is almost or quite restrained; (3) the air-cells being occupied, there is no reason why air-currents should penetrate the bronchi. Hence it would seem that bronchial respiration is but the glottic breath-sound reverberating through the bronchial tubes, and well conducted to the surface. A remarkable experiment of MM. Bondet and Chauveau (*Revue Mensuelle*, 1877) strikingly confirms this view. In a horse with hepatisation of the base of one lung and bronchial breath-sound over the part affected, the trachea was incised below the glottis, and the wound held widely open; the bronchial breathing immediately disappeared, all respiratory sounds ceasing over this portion of lung, whilst elsewhere the vesicular breath-sound was unimpaired. A musical reed was now inserted into the wound, and the musical sounds were well conducted over the consolidation, but little audible over the healthy portion of lung.

Cavernous respiration is a breath-sound in which the inspiration and expiration have both a hollow blowing quality. It is to the expiration that the hollow wavering quality characteristic of this breath-sound is especially attached, and, as pointed out by Dr. R. Thompson, the expiratory sound is lower in pitch than the inspiratory. Cavernous breathing signifies pulmonary cavity usually phthisical—(1) exceeding in size an unshelled walnut; (2) either empty or at least partially so; and (3) communicating with one or more patent bronchial tubes. Softening of tubercle or caseous pneumonia, pulmonary abscess, or bronchial dilatation of sufficient size, are the most common causes of cavity in the lung. This abnormal sound is formed by—(*a*) the passage to and fro of air into a cavity with the respiratory movements; (*b*) the conduction and modified reinforcement of the glottic respiratory sound within a cavity.

Amphoric breath-sound is a variety of cavernous respiration having the same characters, but on an exaggerated scale; that is, not necessarily exaggerated as regards loudness, but having all the qualities—blowing character and hollowness—intensified. This sound is heard over a large superficial cavity, either in the lung, or in the pleura freely communicating with the lung. Its mechanism is identical with that of cavernous respiration, only that the size of the cavity is large.

(*c*) Adventitious Auscultatory Signs.—A *râle* or *rhonchus* is a sound produced by impediment to the entry or escape of air within the lungs or bronchial tubes. The impediment may be from narrowing, or secretion within the tubes; from secretion within the alveoli; or from destructive softening or œdema of the lung-tissue. The *râles* that may be audible over the chest, are —*sonorous, sibilant, crepitant, sub-crepitant, mucous, dry crackling, moist crackling*, and *cavernous*.

Sonorous and sibilant râles are noises of

a snoring or whistling kind, which are produced in the air-passages. They are audible with both inspiration and expiration (or with either), and are for the most part transitory sounds, being temporarily or permanently removed by cough, or in other cases by the relief of the spasm which has occasioned them. They obscure or altogether mask the normal respiratory sounds. Any narrowing of an air-tube will give rise to a sonorous or sibilant *râle* according to the degree of narrowing and the size of the tube. Thus, if the larger tubes be affected, and the narrowing not great, the coarser sound is produced. If, on the other hand, the finer tubes be partially occluded, or a larger tube be greatly narrowed, the finer sibilus is caused. The *râles* are audible throughout the territory of the tubes affected. Thus if a main bronchus be compressed or narrowed, the sonorous *râle* so occasioned will be heard throughout the lung on that side. Throat-sibilus in croup is conducted all over the chest.

The precise causes of these *râles* are—(1) narrowing of a bronchus from external pressure (uncommon); (2) narrowing from local, cicatricial, thickening and contraction of the fibrous coat of the tube (uncommon); (3) mucous collections in the tubes giving rise to imperfect plugs which vibrate, causing the musical sounds (very common); and (4) spasmodic contraction of the medium-sized tubes (sibilus in asthma).

Dry râles signify—(1) Bronchial catarrh, or bronchitis, local or general, as the case may be, affecting the larger and medium-sized tubes; (2) tumours pressing upon the trachea or one of the main bronchi; (3) numerous minute bronchial obstructions occasioned by pulmonary miliary tuberculosis; or (4) asthma.

Stridor is a variety of sonorous rhonchus, due most generally to pressure of a malignant or aneurysmal tumour upon a main bronchus, and heard chiefly over the corresponding side. It is a coarse, vibrating sound, which, however, the trained ear can readily detect to be of distant origin. Paralysis of the vocal cords will, in some cases, lead to stridor.

Crepitant râle, or *fine, dry crepitation*, is a minute, dry, crackling sound, in which the crackles are infinitely small and even, and occupy chiefly the latter part of inspiration. The sound has been compared to the crackling of salt upon the fire, or that produced by rubbing a pinch of hair between the fingers close to the ear. Probably the exact mechanism of the sound is the abrupt separation of alveolar surfaces, collapsed by inflammatory or other œdema. But there are difficulties in the way of any present explanation of the sound. There are at least four conditions which will give rise to identically the same sound, as far as the ear can appreciate it—namely (1) incipient pneumonic consolidation (inflamed œdema stage); (2) œdema of the lungs when not excessive, as in certain stages of kidney-disease, in obstructive heart-disease, &c.; (3) mere collapse of lung from disease, crepitant *râle* being often temporarily heard from this cause at the extreme posterior bases, to disappear after a few deep inspirations; and (4) certain cases of œdema of the pleura dependent upon old lung-disease. The fine crepitation of pneumonia is peculiar only in being associated with commencing tubular breath-sound, the consolidation associated with which gives an increased intensity and definition to the crepitant *râle*. When associated with acute febrile symptoms, fine crepitation indicates the congestive stage of acute pneumonia. If seated about the base, the pneumonia is most commonly of the typical croupous or exudative variety. If at the apex, or in patches, the disease may be incipient catarrhal or embolic (pyæmic) pneumonia.

Sub-crepitant or *muco-crepitant râle* is a fine bubbling *râle*, of sharp definition, and well-conducted to the ear, audible principally during inspiration, but in less degree also with expiration. This *râle* is produced in the minute bronchioles and alveoli, by the penetration of air through a thin liquid. A certain amount of lung-condensation is necessary to give sharpness of definition to the sound. Sub-crepitant *râle* is most typically heard in the resolution stage of pneumonia. In the second (secretion) stage of broncho-pneumonia it is also heard. There are many *râle* sounds intermediate between true dry crepitation and the sub-crepitant *râle*, which are fairly described by the general term crepitant *râle*, fine or coarse, according to their size. Many degrees of fineness or coarseness may be distinguished in different parts of the same lung in some pneumonic forms of phthisis, and it will be generally found in any such cases that the *râles* increase in coarseness as we ascend from below upwards.

Dry crackle is the term used to describe a *râle* consisting of three or four distinct small crackles heard during inspiration. The crackles are dry in character, and sharply defined. The inspiratory breath-sound attending this rhonchus is usually feeble and harsh, the expiration harsh and prolonged, but unattended with any *râle*, unless it be some sibilus. Dry crackling most commonly signifies commencing softening of 'tubercular' deposits, and the sound may be most frequently recognised in the sub-clavicular region, where this condition is most often found uncomplicated by conditions depending upon other stages of the disease.

Moist crackle, or *humid clicking râle*, consists of a few crackles, heard during the latter part of inspiration and the commencement of expiration, sharply defined, sometimes metallic in quality. The crackles vary in size and in the degree of liquidness, as must

be the case from the mechanism by which they are produced. For this *râle* is significant of liquefaction of tubercular or caseous pneumonic nodules in communication with bronchial tubes ; and as such adjacent softenings coalesce and increase in size, the crackles become larger, until they develop into the *gurgling* or *cavernous râle*. The moist crackle may be associated with other *râles*, since a softening caseous nodule is often surrounded by congested pulmonary tissue or pneumonia, giving rise to fine crepitant or sub-crepitant sounds. As a rule, the breath-sound is more or less masked by the crackling *râle*.

Cavernous and gurgling râles are but larger and more liquid *râles*, produced in a cavity or cavities of moderate dimensions.

Metallic tinkling râle requires for its development a large empty cavity in which it may be produced—(1) by the bursting of one or more air-bubbles through viscid contents; (2) by the impingement of a drop of secretion against the cavern-wall; or (3) by a bubbling *râle* produced in a bronchus near the cavity, and freely communicating with it. In either case the large empty cavity, necessarily near the surface, resonates and re-echoes the sounds, and gives them their peculiar metallic quality, which has been likened to that produced by a pin dropping into a large empty bottle. Metallic tinkling is by no means solely significant of pleuritic cavity, as was supposed by Laennec ; it may be most typically heard over a large dense-walled empty pulmonary cavern.

Metallic echo is sometimes confounded with metallic tinkle, with which it is often associated, and, indeed, of which it may be said to form a part. It is really not a *râle* at all, however, but an echo in a large cavity, produced—(1) by air-vibrations caused by cough ; (2) by vibrations on the surface of fluid with a large air-space above ; or (3) by vocal vibrations reaching through the cavity after true voice-sound has died away.

Hippocratic succussion-sound is the splashing sound heard in a pleura containing both air and fluid, on shaking the patient somewhat vigorously, while the ear is applied to the chest-surface.

Cough-sounds.—A cavernous splash-sound may frequently be heard on listening over a cavity, and causing the patient to cough, the forcible entry of air into the cavity in itself largely contributing to the sound, and setting up gurgling and splashing *râles* by the disturbance of contained fluids.

Cough-sounds require no explanation, but they should be invariably tested in chest-examination. Crepitant sounds are often developed after a cough, which are not to be heard either on ordinary or deep inspiration without it. *Cavities* which are not in free communication with bronchial tubes may yield no characteristic breath-sounds ; but the forcible propulsion of air into them at the moment of chest-compression with closed glottis elicits at once a characteristic localised succussion-sound, attended with more or less coarse gurgling *râle*.

Voice-sounds.—In the ordinary healthy spongy condition of lung, the voice-sounds are heard but distantly and imperfectly, save in certain parts of the chest in the neighbourhood of the trachea and its bifurcation—that is, in the upper sternal and the upper interscapular regions, where the sounds are better conducted.

Bronchophony.—At any portion of the chest where there is consolidation of lung, in association with patent air-tubes, the voice-sound is heard loudly, as though produced near or close, under the stethoscope. Although loudly heard, the sound appears to pass away from under the stethoscope. Any solid medium of conduction between a large bronchus and the stethoscope will give rise to bronchophony, whether by super-position, or by the portion of bronchial tree concerned being imbedded in solid lung, as in lobar pneumonia, of which the sound is most typical. If, however, between the conducting medium and the larynx the bronchial channel be occluded, bronchophony is no longer heard, the voice-sounds being enfeebled or annulled.

Pectoriloquy.—If, on the other hand, a cavity be present beneath the spot auscultated, and in free communication with a bronchus, the voice-sound appears to be concentrated at the end of the stethoscope, and to pass *through* the instrument direct to the ear, with exaggerated and even painful distinctness. It is rather the *noise* of the voice that we hear in bronchophony, but in pectoriloquy the sounds are most distinctly *articulated*. This distinction is even better appreciated by listening to a whisper, which under bronchophonic conditions is merely a conducted hissing sound, whilst in pectoriloquy each syllable penetrates distinctly to the ear. Pectoriloquy may, however, be clearly, although not exactly, imitated by consolidated lung in the neighbourhood of a large bronchus. Hence the diagnosis of a cavity near the root of the lung requires much caution.

Ægophony.—Ægophony is a form of modified bronchophony in which the voice-sound, conducted through condensed lung, has further to penetrate a thin layer of fluid in which the coarser vibrations are lost, a certain quavering nasal quality being given to the sound that reaches the ear. It is significant of effusion into the pleura. The sound is only to be heard near the upper limits of the effusion, where the layer of fluid is thin.

With regard to the mechanism of these three sounds—bronchophony, pectoriloquy, and ægophony—there can be no dispute about their being glottic sounds. In *broncho-*

phony they are conducted through subdividing tubes of increasing fineness enveloped in solid tissue; hence the sounds, although loudly heard, are not well-defined, being largely converted into the coarser vibrations perceptible to palpation as *fremitus*. In *pectoriloquy*, on the other hand, the glottic sounds are conducted through tubes which, after one or two divisions, terminate in a resonating cavity; hence the vocal vibrations are concentrated and conducted with intensity to the ear as through a speaking-tube. Finally, in *ægophony* one may suppose the bleating character of the sound to be due to secondary, and to a certain extent disturbing vibrations in the fluid medium through which the sounds are conveyed. In ægophony one may commonly note a lisp or whisper-sound in addition to the voice-sound, and better conducted than the voice-sound. And it has been affirmed by Bacelli that in cases of *serous* effusion into the pleura the whisper is heard well-conducted with distinct articulation—*pectoriloquie aphonique*—through the thickness of the fluid, whereas in *purulent* effusion such whisper is not conducted. This statement will be found to apply, however, only in certain cases. The whisper may sometimes be heard well-conducted through purulent fluid.

The voice-sounds are *weakened* or wholly *extinguished* by conditions which: (*a*) shut off the main bronchi from the part auscultated, as in malignant growths invading the bronchus at the root of the lung; (*b*) separate the lung-surface from the thoracic wall, as in pleuritic effusions, œdematous thickening of pleura, &c. Here, however, we must make exception in certain cases, in which pectoriloquie aphonique is heard. In (*c*) rarefaction of the lung by emphysema the voice-sound is enfeebled; and in (*d*) pneumothorax it is either much enfeebled or annulled. In cases of pneumothorax, however, a faint *metallic echo* may often be heard with, or rather after, the voice-sound. This echo has probably a precisely analogous mechanism to ægophony, save that the medium of secondary conduction is air instead of fluid, and hence the conduction is less distinct.

Autophony.—On listening over a superficial cavity with condensed lung-tissue around, the voice of the auscultator—for example, when requesting the patient to cough or to speak—will be noticed by himself to be intensified. The term *autophony* is applied to this increased resonance, which is a sign of little clinical value.

Pleural sounds.—The sounds originating in diseased conditions of pleura are commonly included under the general term 'friction sounds'—a term, however, very inadequate to describe the varieties.

The *pleuritic rub* or *dry friction* is a wavy or uneven rubbing sound heard close under the ear with both inspiration and expiration, but chiefly with the former, unmoved by cough, and usually attended with pleuritic pain. We may often fail to obtain this sound, through the patient involuntarily restraining the movement of the affected side on account of the pain. A deep inspiration must, therefore, be always called for. In well-marked cases the friction is very loud and leathery, and may be perceptible to the hand applied—*friction fremitus*.

Pleural creaking is a sound that may be sometimes distinguished over a portion of the chest, when the pleuræ are densely thickened and adherent.

Moist or spongy friction is most difficult to distinguish from fine moist crepitation. It is heard almost entirely at the end of deep inspiration, and closely resembles the crepitation of a moist sponge. The sound is due to the pleura being adherent by moist, recent lymph, as in the early stage of adhesive pleurisy in pleuro-pneumonia.

In cases of œdema of the pleura a fine crepitating inspiratory sound or *pleural crepitus* may be heard, which it is impossible to distinguish from a pulmonary sound. The diagnosis must rest upon the very superficial character of the sound, and its being unchanged by cough; also upon its being associated with deficient breathing without tubular quality, and with lessened vocal fremitus. It is an inspiratory not an expiratory sound, being engendered by the pulling out of the spongy œdema-tissue during inspiration.

4. Circulatory System, Physical Examination of.—The condition of the heart and circulation may be investigated with great exactness, chiefly by palpation, percussion, and auscultation.

PULSE.—The pulse gives us very important information respecting the state of the circulation. For a full description of the pulse and its different characters in disease, *see* PULSE, THE; and SPHYGMOGRAPH.

HEART.—(*a*) **Inspection.**—In health and during quietude the cardiac impulse is barely perceptible. Under excitement, however, throbbing impulse may be noticed over the præcordia and left epigastrium. In cases of great hypertrophy and dilatation of the heart, especially in children, the præcordial region may be obviously bulged. The impulse of the heart may be observed to be diffused over an increased area, between the nipple line and sternum, in cases of hypertrophy and dilatation. In cases of dilated hypertrophy of the right ventricle, or in displacement downwards of the heart in emphysema, the impulse is very perceptible at the epigastrium to the left of the ensiform cartilage. A diffused undulating impulse may be observed in some cases of pericardial effusion and in adherent pericardium. The heart is often uncovered, and its impulse revealed on one side or the other by retraction of the

lung in contractile or wasting pulmonary diseases.

(*b*) **Palpation.**—The position of the heart's apex should first be ascertained; and the area, force, and rhythm of the cardiac pulsations, and the presence or absence of thrill or other adventitious palpation-signs, should next be noted.

Normally the heart, enclosed in its own pericardial sac, is situated in the anterior and central part of the thoracic cavity, immediately above the diaphragm. Its position may be roughly defined as within the area bounded above by a line drawn across the sternum at the level of the lower border of the second cartilages; on the left by a vertical line passing just within the left nipple; and on the right by a similar line drawn at one-third of the distance between the border of the sternum and the right nipple line. A slanting line from the base of the ensiform cartilage to the upper border of the sixth rib in the left nipple line defines the lower border of the heart. Behind this area the heart lies obliquely, its base directed upwards to the right and backwards, its apex to the left downwards and forwards. The organ, moreover, is so placed that the right auricle and ventricle occupy nearly the whole anterior surface; the left auricle and ventricle the posterior and left surface.

The apex of the heart in the adult impinges in the fifth interspace, one inch within the left nipple line. The aortic and pulmonary valves correspond with the upper border of the third left cartilage at its junction with the sternum, the aortic being on the right of and a little lower than the pulmonary. A line drawn from the middle of the third loft cartilage as it joins the sternum, to the upper border of the fifth right cartilage at the sternal margin, would correspond with the mitral valve superficially and above, the tricuspid more deeply and below.

An *altered* position of the apex-beat may arise from congenital displacement of the organ, for example, from transposition of viscera. It may arise from enlargement of the organ by hypertrophy or dilatation, affecting its right or left cavities; or from displacement of the organ, for instance, *downwards*, by emphysema, aneurysm, or tumour; *aside*, by pleuritic effusion, malignant disease, or contraction of lung; *upwards*, by abdominal distension, disease in the abdomen, or contraction of lung.

In continuance of palpation, the condition of the arteries and veins at the root of the neck must be observed: whether the arteries unduly pulsate, or the voins on one side or both remain full, or pulsate.

(*c*) **Percussion.**—The præcordial dulness may be enlarged by retraction of the margin of one or both lungs; by effusion of fluid into the pericardium; or by enlargement of the heart itself, either gencral or restricted to one or more of its divisions. The cardiac dulness may be diminished or obscured by enlargement of the lungs enveloping it, or by gas in tho pericardial sac.

(*d*) **Auscultation.**—By the simultaneous contraction of the ventricles, the closure of the mitral and tricuspid valves, and the impingement of the apex of the left ventricle against the ribs, a single sound is produced, the first sound of the heart. The sudden tense closure of the mitral valve is the principal cause of this sound. The first sound is closely followed by the second sound, which is more tapping in quality, and corresponds with the closure of the aortic and pulmonary valves. Then comes the diastolic pause, which may be said to equal in duration that of the two sounds. The first sound is most loudly heard at the apex, the second at the base of the heart.

The sounds of the heart are subject to considerable variations under varied general conditions of health and disease.

(1) In general debility, anæmia, and wasting diseases, the tendency is for the first and second sounds to approximate to each other in character. As the ventricular wall becomes atrophic or ill-nourished the first sound becomes more purely valvular, and at the same time more feeble and tapping, approaching thus in character to the second sound. Sometimes in cases of anæmia the first sound is peculiarly ringing and hollow in character.

(2) In chronic Bright's disease, with thickened vessels and hypertrophied ventricles, the first sound is peculiarly muffled and indistinct, compared with the recognisable force of the beat.

(3) The rhythm of the heart's sounds may be greatly changed: (*a*) The first or second, or both first and second sounds, may be reduplicated. This may occur as a temporary phenomenon in apparent health, but it is more commonly traceable to increased resistance either in the pulmonary or systemic circulation. (*b*) Excessive rapidity of action. (*c*) Irregularity in time and force of beats. (*d*) Intermittent action. These several phenomena may be significant of disease of the heart itself; or, as is frequently the case, they may be due to functional disturbanco through the nervous apparatus, from dyspepsia; or from oxcessive smoking, tea-drinking, or venery.

A *murmur* or *bruit* is an abnormal sound, invariably of a blowing character, which may moro or less replace or obscure the normal heart's sound. Either of the sounds of the heart may bo replaced or attended by a murmur; and in auscultation, with regard to prognosis, it is much more important to note whether a murmur wholly or only partially replaces the normal sound—that is, whether tho function of the valve be wholly or only partially disabled—than to be guided by mere loudness of *bruit*. The first sound at

the apex may be preceded, or, very rarely, succeeded by a murmur. For a description of these murmurs, and of morbid pericardial sounds, *see* HEART, VALVES AND ORIFICES OF, Diseases of; HEART, Functional Disorders of; and PERICARDIUM, Diseases of.

5. Mediastinum, Physical Examination of.—Having examined the thorax with regard especially to the great organs, the lungs and heart, contained within it, the mediastinal region should next be explored, both anteriorly and posteriorly.

NORMAL SIGNS.—The anterior mediastinal region, clinically speaking, corresponds with those portions of the sternum not underlain by lung, namely, the manubrium and the left half of the body, extending from the fourth cartilage downwards.

The lungs normally approximate beneath the upper portion of the second part of the sternum; from that point to the lower border of the fourth cartilages hiding the subjacent parts. In the triangular space behind the *upper* sternum, with its apex at the lower border of the manubrium and its base at the episternal notch, lie the inferior extremity of the trachea, covered by the left innominate vein, the summit of the arch of the aorta, and a prolongation of the pericardial sac, with connective tissue, and a few small lymphatic glands. The summit of the arch of the aorta corresponds with the level of the upper border of the second rib-cartilage.

Imperfect percussion-dulness and modified bronchial respiration, with weakly conducted heart-sounds, are usually presented over this region. On deeply depressing the finger behind the sternum in the episternal notch, a slight pulsation, communicated from the aorta—which vessel, however, the fingers cannot reach—is felt. The lower region of mediastinal dulness, that is, below the fourth cartilage level, is continuous on the left of the sternum with the heart's dulness, and, indeed, corresponds with the præcordial region.

MORBID SIGNS.—The *upper* mediastinal dulness may be replaced by resonance—(1) from enlargement of the lungs in emphysema; (2) in cases of contraction of the upper part of one lung, enlargement of the opposite lung wholly occupying the sternal region, and effacing the normal mediastinal dulness. The limits of normal mediastinal dulness may be *extended*, from displacement of the anterior margin of the lungs—(1) by dilatation or aneurysm of the aorta; (2) by mediastinal abscess; (3) by simple enlargement of the mediastinal or thymus glands; or (4) by morbid growth—cancer, or lymphoma. (For the diagnosis between these several conditions, *see* AORTA, Diseases of; and MEDIASTINUM, Diseases of.) It must be borne in mind that considerably increased dulness, and even prominence, may be due to intrinsic disease of the sternal bone, or to thickening from periostitis.

Alterations in the boundaries of the *lower* region of mediastinal dulness are most often due to enlargement of the heart, or dilated pericardium. Aneurysm of the aorta or the heart, or a growth extending forwards, between the heart and the lung, from the posterior mediastinum, are the other causes of increased inferior mediastinal dulness.

Posteriorly there is no inter-pulmonary space apparent save that occupied by the spinal column. But in disease, and especially in tumour, whether aneurysmal or of the nature of morbid growth affecting the root of the lungs (*see* BRONCHIAL GLANDS, Diseases of), the posterior mediastinal dulness involves the right or left interscapular region, as the case may be.

The bifurcation of the trachea corresponds with the body of the fourth dorsal vertebra. The descending portion of the arch of the aorta corresponds with the left side of the third dorsal vertebra.

6. Abdomen, Physical Examination of.—The abdomen is that portion of the body included between the diaphragm above and the brim of the true pelvis below; and is usually divided, for convenience of clinical reference, into regions. Two horizontal lines drawn at the level of the ninth ribs, and the highest point of the crest of the ilia respectively, and intersected by vertical lines drawn from the eighth rib on each side down to the middle of Poupart's ligament, divide the abdomen into nine regions, namely, epigastric, umbilical, and hypogastric in the middle; and hypochondriac, lumbar, and iliac on each side, from above downwards.

(*a*) **Inspection.**—When examining a case of abdominal disease the position naturally assumed by the patient should be noticed: whether it be indifferent; or dorsal with the knees drawn up—a position very characteristic of peritonitis; or lateral, with the thighs flexed and the body bent, as in renal or hepatic colic. Sometimes in cases of colic, especially lead-colic, the patient lies on his belly with the arms compressing the part. Frequent changes of posture are also characteristic of colic rather than of peritoneal inflammation. The general size, shape, tenseness, flaccidity, or retraction of the abdomen will be next observed. Any alteration from perfect symmetry will be noted, with the region of any swelling. The superficial veins of the abdomen may be enlarged, the internal mammary from above meeting the superficial and deep epigastrics, to secure collateral circulation between the superior and inferior cavæ, when either is from any cause compressed or occluded.

(*b*) **Palpation.**—On placing the hand over the abdomen for the purpose of palpation, the rigidity or otherwise of the muscles, especially

of the recti, will be noticed; and the observer will be careful to note whether the musclo becomes contracted during manipulation, or was from the first unduly tense. The muscles of the abdominal walls are rigid, as a rule, in all inflammatory conditions of the peritoneum. In local peritonitis, and over special organs or tissues which are painful, the muscles are also tense; thus it is not uncommon to find one rectus notably more rigid than its fellow.

In order properly to examine the abdomen by palpation, it is necessary to place the patient flat on his back, on a slightly inclined plane, with a round pillow placed under the head, so as to flex the chin upon the sternum. The thighs should be similarly flexed upon the pelvis by means of a second incline, on which the legs should rest, or by placing one pillow beneath the thighs and two pillows beneath the legs. In this manner the muscles of the abdomen will be rendered as lax as possible. The patient should further be held in conversation, or told to breathe deeply, but without effort, in order that he may not keep his diaphragm fixed. It is often a good plan, when other efforts fail to prevent the patient from keeping his diaphragm fixed, to make him go on counting 'one,' 'two,' 'three,' up to as high a number as he can possibly reach without drawing breath. In this manner we get the diaphragm thoroughly relaxed; and by keeping the hand on the abdomen, deep palpation can be effected at any period of the counting most suitable for the purpose. The observer should be comfortably placed at about the same level as his patient. The whole hand, previously warmed, should be evenly applied to the surface, and the fingers then depressed in different directions as the hand is smoothly conveyed to different regions. If the patient be poked about with the ends of the fingers by the physician stooping over him, he is either tickled or hurt, his muscles contract, and proper examination is impossible.

It is sometimes useful to make the patient change his position first to one side, then to the other. This method is particularly to be adopted in examining tumours which are movable, such as floating kidneys, some uterine tumours, and aneurysmal sacs. In the case of tumours lying over the aorta, it may be impossible, without adopting this plan, to be sure whether the pulsation felt over them is communicated or intrinsic.

It is sometimes doubtful whether a tumour is situated within the rectus muscle, or in the abdomen beneath it. By keeping the hand over the tumour and making the patient raise himself half to the sitting posture, so as to cause the recti to start forward in contraction, this point can be cleared up.

The temperature of the surfaco of the abdomen to tho hand applied, and to the surface thermometer, may be distinctly raised above that of the general surface in peritonitis.

It is often difficult to estimate the true degree and nature of pain in the abdomen caused by pressure. In hyperæsthesia of the surface the slightest pressure causes suffering; whilst deep, even palpation gives little inconvenience. If the surface be pinched up the pain is acute. Pain in the abdominal muscles is less acute, and is intensified by bringing these into action. The pain of peritonitis is superficial in so far as it is commonly associated with hyperæsthesia of surface; but gentle, steady pressure is acutely painful, and deep palpation intolerable. The pain of peritonitis may, with the diseasc, be general or local. There is often some difficulty in differentiating the pain of localised hyperæsthesia—hysterical pains as they are called—from those of inflammatory origin or from tenderness of organs. By holding the patient persistently in conversation respecting symptoms associated altogether with another part, as minute inquiries about headache, cough, &c., and thus keeping off attention whilst the hand is steadily compressing the supposed painful parts, all doubts can be removed. In neuralgic and hysterical pains simulating peritonitis, the tenderness extends beyond the confines of the peritoneum.

Abdominal organs may be tender to palpation.

Fluctuation.—Fluctuation is an important sign of the presence of fluid in the abdomen, whether the fluid be free in the peritoneum or enclosed in a sac. It may be obtained by placing one hand lightly on the abdomen, whilst the fingers of the other hand smartly tap over another part, when a fluid wave will be felt to impinge against the applied hand. In certain tense conditions of the abdomen, a deceptive sense of fluctuation may be obtained from the vibrations of the abdominal walls. To prevent this fallacy the hand of a bystander should be applied edgewise on the abdomen, midway between the two hands of the observer, so as to check superficial vibrations.

Hydatid fremitus.—This is a kind of tense fluctuation appreciable by the pleximeter finger on sharp percussion over certain cysts, more particularly hydatid cysts. *See* ENTOZOA.

(*c*) and (*d*) **Percussion and Auscultation.**—Percussion and auscultation of the abdomen are adopted in accordance with the methods already described. The distribution of dulness and resonance, varying or not with the position of the patient, affords important evidence respecting fluid collections, whether peritoneal or encysted. *See* ABDOMEN, Diseases of; and ASCITES.

By auscultation friction-sounds may be heard over the seat of peritonitis; vascular,

aneurysmal, and placental bruits; or the sounds of the fœtal heart may be detected.

Physical Examination of the Liver.—In the right mammary line the liver underlies the region from the fifth rib to the costal margin: in the median line from the base of the xiphoid cartilage to an inch and a half below that level. The left extremity of the liver lies just within and behind the apex of the heart. It may, then, be roughly said that a horizontal line drawn from the base of the xiphoid cartilage to the right side of the chest and to the apex of the heart, and a second line slanting from within the apex-beat to the right costal margin in the nipple line, would mark the site of the liver. It has already been observed how this surface is partially covered above by lung. In health the margin of the liver becomes lost to palpation beneath the cartilages in the right nipple line. Its upper margin may be defined, as already shown, by deep percussion, its lower margin by very light percussion.

Displacements.—The liver may be *lowered* in position by certain thoracic conditions, such as emphysema, fluid in the pleura or pericardium, thoracic tumours, or compression by tight-lacing. When the liver is thus lowered, it is somewhat anteverted; and in lax conditions of the abdomen its lower margin may be covered by a coil of intestines, thus requiring somewhat deep palpation in tracing it.

The liver may be *raised* by contractile thoracic diseases, especially on the right side, so that its margin recedes considerably within the costal margin. In cases of doubt as to whether extension of dulness upwards be liver or lung consolidation, the observer must notice whether the level be shifted by respiratory movements. When the abdomen is distended from any cause, the liver is pushed upwards; and in this case, and also in many instances where the liver is drawn upwards, it becomes also tilted somewhat backwards, so that but little more than the margin presents anteriorly. In this condition there may be but little, if any, liver-dulness discoverable anteriorly, and it may erroneously be concluded that the liver is much diminished in size. In these cases, however, the posterior dulness of the liver is increased in the right lower thoracic region. In cases of enlargement of the liver, therefore, the upper margin must be accurately defined, to see if there be extension upwards, and whether that extension be even or uneven. The lower margin must be traced by palpation; the *mobility* of the organ with respiration estimated; its hardness, softness, sharpness, evenness, or distortion ascertained; and whether it be free or connected with other parts—for example, the spleen, or an abdominal tumour.

The lower margin of the liver, when the organ is enlarged or depressed, very frequently cannot be defined by percussion, being overlapped by intestines. For instance, in cases of lax abdominal parietes, with moderate fluid effusion in the peritoneum, the intestines float up and press between the margin of the liver and the surface. In other cases the front surface may be unduly rounded, and the margin thus incurvated to a certain extent and covered by intestines. The *surface* must be felt—whether smooth, or rough, or nodulated. The *consistence* must be estimated by palpation—whether hard or soft, or fluctuating at any part. *See* Liver, Enlargements of.

The *gall-bladder* cannot be felt unless it be distended, when it presents as a rounded tumour attached to the margin of the liver in the right nipple line. *See* Gall-Bladder and Gall-Ducts, Diseases of.

Physical Examination of the Spleen.—Normally, splenic dulness may be ascertained on light percussion in an area on the left side extending from the ninth to the eleventh ribs, and between the mid-axillary and mid-scapular lines. The shape of the splenic dulness is oval in the slant of the ribs.

In moderate *enlargement* the splenic dulness is increased in all directions; and on placing the hand deeply in the left flank, close under the ribs, the organ may be felt to descend upon it during inspiration. As the organ still enlarges it comes forwards and downwards, raising the apex-beat of the heart, occupying the region in front of the scapular line and below the level of the apex-beat, and projecting downwards beneath the costal margin into the abdomen. As the organ still further enlarges, the anterior margin curves forwards, forming nearly a right angle with the costal margin. It is usually sharply defined, and may extend forwards to the median line, and downwards to the pelvis. The posterior margin of the enlarged spleen is also, in such cases of great enlargement, to be felt thick and rounded immediately in front of the quadratus muscle. An enlarged spleen extending into the abdomen is superficial in its entire area; its anterior and posterior borders are well-defined; and it can usually be moved between the two hands forwards and backwards. The notch may be commonly felt. The surface may be quite even or nodulated. Sometimes on auscultation a bruit may be audible over an enlarged spleen. Friction-sound may also sometimes be heard. Certain alterations in the constitution of the blood and in the temperature of the body are intimately associated with diseases of the spleen, and the examination of these conditions forms an important item in their diagnosis.

Diminution in the size of the spleen cannot be accurately estimated, and is of little clinical moment.

Physical Examination of the Kidneys.—The kidneys, when of normal dimensions.

cannot, as a rule, be felt, especially in fat people, or when the abdomen is enlarged. They lie one on either side near the spinal column, between the level of the spinous process of the eleventh dorsal and of the second lumbar vertebræ, and in the mid-line between these spinous processes and the outer margin of the flank. Imbedded in fat, they rest on the lumbar muscles. The right kidney is overlain in part by the liver, colon, and intestines; the left by the stomach, colon, and intestines.

In order to feel for the kidney, the patient should be placed in the position for abdominal examination. The observer, standing on the side opposite that of the kidney under examination, then places one hand along the mid-flank behind, immediately below the last rib; the other hand should rest upon the corresponding part of the abdomen in front, firmly depressing and manipulating deeply, so as to bring the site of the kidney between the phalangeal portions of the two hands. At the same time the patient should be made to inspire and expire deeply; and it is during the stage of moderately deep expiration that the organ will usually be felt.

Tenderness of the kidney, if present, may thus be estimated with certainty. Undue rigidity of the muscles on one side may be observed.

If the kidney be *uniformly enlarged* it simply extends downwards, and comes more readily under observation. In great enlargement of the kidney, as in cancerous tumour, or of its pelvis, as in pyelitis, the organ forms a tumour occupying the flank, and coming forwards from behind the colon towards the front of the abdomen. Such a tumour is more or less pyramidal or rounded in form, with a distinct band of resonance corresponding with the superior flexure of the colon extending across it. The tumour may be solid or fluctuating, according to its nature. Renal tumours are most common on the left side. The pelvis of the kidney, except when considerably dilated, does not come under palpation. *See* KIDNEYS, Diseases of.

Movable kidneys.—The mobility of the kidneys varies much, from mere laxness to complete dislocation. *See* KIDNEYS, Diseases of: 25. Kidney, Malpositions of.

The examination of the urine forms the most important part of the physical diagnosis of kidney-diseases. *See* URINE, Morbid Conditions of.

PHYSICAL EXAMINATION OF THE PANCREAS.—In thin subjects with retracted abdomen, the head of the pancreas may be felt as a small, somewhat angular, tumour to the right of the median line, above the level of the umbilicus, in the region, in fact, of the pylorus, with thickening of which it may readily be confounded.

Cancerous enlargement of the pancreas extends forwards, in or near the middle line, above the umbilicus, presenting a tumour difficult to diagnose. *See* PANCREAS, Diseases of.

PHYSICAL EXAMINATION OF OTHER ABDOMINAL VISCERA.—Diseases of the *stomach* and *intestines* yield their proper signs, requiring no separate description here. Tumours of the *omentum* have to be distinguished, by the method of exclusion, from affections of the solid organs of the abdomen.

The *pelvic organs*—uterus, and ovaries, and bladder, under certain conditions of enlargement—present themselves for diagnosis as abdominal tumours.

When distended, the *bladder* gives rise to a pyramidal area of dulness extending in the median line from the pubes, broadening upwards, towards or even beyond the umbilicus. The tumour is firm but elastic, on palpation tender, and is at once removed by successful catheterisation.

In pregnancy at the fourth month the *uterus* becomes perceptible to deep palpation in the pelvic basin in the pubic region. At and beyond the fifth month a tumour of growing dimensions extends from out of the pelvis towards and beyond the umbilicus. Dulness on percussion extends from the pubes over the whole front of the tumour, whilst above and in the flanks a resonant intestinal note is obtained. The relations of dulness and resonance are not appreciably changed by position. The tumour is elastic, and in the advanced stages obscurely fluctuating. On deep palpation, an irregular resisting lobulated mass is to be felt; and on keeping the hand steadily applied, undulating movements, or a distinct shock or jerking movement, may from time to time be felt. On applying the stethoscope with somewhat deep pressure, half-way between umbilicus and pubes and a little on one or other side, the rapid beat of the fœtal heart may be distinctly heard, closely resembling the tick of a watch under the pillow. On bringing the stethoscope nearer the inguinal region (usually on the right side), the soft low-pitched placental *souffle*, synchronous with the maternal pulse, is to be heard. Enlargement of the uterus from other causes, especially fibroid and fibro-cystic growths, may lead to abdominal tumours, which are diagnosed by combined vaginal and abdominal examination. *See* WOMB, Diseases of.

Ovarian tumours also present in the abdomen, extending upwards from one or other side of the pelvic region, and with a disposition as they extend to become central. They are most commonly cystic, and—especially in the later stages—sometimes present difficulties in diagnosis from pregnancy or peritoneal dropsy. *See* ABDOMEN, Diseases of; ABDOMINAL ANEURYSM; AORTA, Diseases of; OVARIES, Diseases of; and other appropriate headings.

R. DOUGLAS POWELL.

PHYSIOGNOMY (φύσις, nature; and γνώμων, an interpreter).

DEFINITION. — Physiognomy originally meant the interpretation of the nature of an individual by the light of the indications afforded by his countenance, conformation, and movements; but the term is frequently used for the indications themselves.

PHYSIOGNOMY IN DIAGNOSIS.—In the early ages of medical science the doctrine of physiognomy formed an important part of all systematic teaching. In proportion as the means and practice of physical diagnosis have been developed, physiognomy, being insusceptiblo of exact treatment, has fallen into the background, and is seldom assigned a definite place among methods of investigation. Yet in every description of disease the indications yielded to inspection have their place; and practically it is no small part of the accomplishment of a skilful physician to be able to recognise readily in any sick person the outward signs which may be characteristic of his malady.

The authors who have treated systematically of physiognomy make it, in the first place, subservient to the definition of certain morbid temperaments, to which the name of *diatheses* has been given. When in any case the tendency belonging to a diathesis has gone on to the production of an actual diseased state, the word *cachexia* has been commonly adopted to express the fulfilment of the first physiognomical prophecy, with an extension of application to diseased states produced by accident, or without precedent sign of the existence of the corresponding diathesis. Among modern English authors on medicine, Dr. Laycock was conspicuous in allotting an important place to the 'physiognomical diagnosis of morbid constitutional states.'

ELEMENTS OF PHYSIOGNOMY.—Besides such larger groups of physiognomical indications, there are smaller groups, and even single features, which relate to particular systems of organs, or to individual parts, and which, in proportion to their limitation, have mostly a more precise meaning. Before enumerating some of these, it may be of advantage to review the elements of physiognomy. These are, in the main, four: (1) *tegumentary*—skin, with glands and blood-vessels, mucous membrane of mouth and throat; (2) *muscular*; (3) *skeletal*; (4) *attitudes* and *movements*, including those of speech.

The *skin* presents a large number of points for observation; for example, its colour, as regards pigmentation, and as regards vascularity; its texture, as regards softness or hardness, smoothness or roughness, thickness or fineness, toughness or flexibility, dryness or moisture; the development and distribution of glands and hairs; œdema; tumours, such as warts; and eruptions. Besides these, in the face, lines, furrows, and ridges mark the excessive or defective action of particular muscles, whether determined by habit or disease, causes which also determine the shape of the orifices and skin-prominence of the face.

As regards *muscular* variations there may be noted protective contractions, to which Mr. Darwin has drawn attention as part of the basis of the expression of the emotions, protective relaxation, reflex contractions, spasmodic contractions, and paralysis. With the conformation of the *bones*, which form the framework upon which the skin and muscles are moulded, must be associated the teeth, organs rich in information touching the health of the mucous membranes during childhood, and of the system at large throughout life.

APPLICATIONS OF PHYSIOGNOMY.—Many of the correlations between physiognomy and disease are fully discussed in other parts of this work. A few illustrations of the use of the method may, however, be cited in this article.

The *skin*, alone, may yield indications suggestive, pathognomonic, or diagnostic, as the case may be. Of the first kind are the staining of jaundice, the contrasted tints of hectic, the alterations of the hair in various diseases; of the second kind are the eruptions of exanthematous fevers and syphilis; of the third kind is the observation of Sir Spencer Wells, in dealing with the diagnosis of ovarian and uterine tumours, that 'there is a facial expression common to women suffering from both classes of disease, associated with a very florid complexion when the tumour is uterine, whereas in the majority of ovarian cases the complexion is pallid.' In the mucous membrane of the mouth the blue line on the gums in chronic lead-poisoning, the spongy gums of mercurial poisoning and of scurvy, and the pigmentation of Addison's disease, are, approximately, instances of the three kinds of signs.

In the *muscles*, independently of the various evidences of paralysis, we may refer to the 'risus sardonicus'; to the tumid, expressionless upper lip of progressive muscular atrophy (Duchenne); to the fixed bent attitude of the head, and rigid, imperturbed features and unaltered articulation of paralysis agitans, as compared with the shaking head and scanning articulation of disseminated sclerosis, or the fatuous look which accompanies the irregular movements of chorea. The physiognomy in plague is said to be highly characteristic. *See* PLAGUE.

The *bones* contribute also to our information. They present definite changes of form in rickets, the projecting under-jaw which in many women is associated with pelvic deformity, the enlargement of the cranium in hydrocephalus, and the hour-glass head and altered teeth of inherited syphilis.

As in the diatheses all the four systems

co-operate to form a characteristic physiognomy, so in many actual diseases complex manifestations are abundantly presented. The changes observed in the face and neck in association with certain affections of the chest may be selected as illustrating well this kind of grouping. Thus in severe cases of chronic bronchitis, with emphysema, the skin is turgid, blue, purple, or livid, the lower lip especially being discoloured, enlarged, and everted; the veins, particularly in the neck, are full and prominent; the brows are knitted; the eyeballs projected, the eyelids swollen and partly contracted; the lower jaw, if not closed, is rigidly set in a way to give full effect to the action of the central muscles raising the sternum, which, with the sterno-cleido-mastoids, are prominent and strong; the head is bent forward, the shoulders raised, the nostrils expanded and thickened. The entire expression is one of strain and anxiety. If there be, as is often the case, tricuspid regurgitation, the veins of the neck may be seen filled during every pulsation of the heart.

In certain forms of advanced disease of the heart there is the same swelling and discoloration. But there is usually some icteric tinging of the skin and conjunctivæ, and much weaker signs of muscular strain, which in emphysema are brought about by the constant inspiratory effort. The face is generally calmer in expression, and the head rather thrown back than drawn forward.

When an aneurysm or intrathoracic growth presses on the structures in the upper part of the chest, the face often presents enormous venous turgidity, and the veins at the root of the neck are often permanently distended, and unaffected by the movements of respiration, sometimes on one side, sometimes on both. If there be pressure on the trachea or large bronchi, or if there be paralysis of the recurrent laryngeal nerve, many of the muscular strains already noticed may be present; if there be paralysing pressure on the sympathetic, the pupil on the same side will be comparatively contracted, all the tissues on the side more swollen, and the secretions increased. If with aneurysm there be aortic regurgitation, violent pulsation of all the arteries will usually be noticed, bringing into strong relief arteries generally quite unseen.

In these illustrations the appearances seen in the head and neck only are considered. If the modification of bodily conformation, movements, and attitudes which go to make up the full physiognomical picture were also detailed, a large addition, exceeding the limits of this article, would be involved. But even so much as is here portrayed will serve to remind us of the large amount of suggestive information which may be gleaned by the observer before proceeding to actual physical examination of the patient, and may stand for an example of the process which, under careful training and practice, is at last performed almost unconsciously by the experienced physician.

William M. Ord.

PHYSOMETRA (φῦσα, air; and μήτρα, the womb).—A condition in which a collection of gas or air is formed in the uterus. *See* Womb, Diseases of.

PHYTOSIS (φυτόν, a plant).—A generic term for plant-formation, applicable to epiphytic, phytiform, or parasitic diseases of the skin, of which there may be enumerated the following species: *Phytosis* or *tinea tonsurans*; *phytosis* or *tinea circinata*; *phytosis favosa* or *favus*; and *phytosis versicolor*. *See* Favus; Tinea Tonsurans; and Tinea Versicolor.

PIA MATER, Diseases of.—*See* Meninges, Cerebral, Inflammation of: 3. Leptomeningitis.

PIARHÆMIA (πῖαρ, fat; and αἷμα, blood).—A morbid condition of the blood, in which it contains free fat. *See* Blood, Morbid Conditions of.

PICA (*pica*, a magpie).—A perversion of appetite, characterised by a craving for various substances unfitted for or incapable of digestion. *See* Appetite, Disorders of.

PIETERMARITZBURG, in Natal. *See* Africa, South.

PIGEON-BREAST.—A deformity of the chest, in which the ribs are flattened laterally and the sternum thrust forward, so that the chest assumes somewhat the shape of the breast of a pigeon. *See* Chest, Deformities of.

PIGMENTARY DISEASES OF THE SKIN.—General Statements.—Derangement of the pigmentation of the skin may be in the direction either of excess or of deficiency, and either congenital or acquired. These defects usually occur separately, but may be associated together in the same individual, as in leucoderma and melanoderma.

The special affections of *excessive* pigmentation are Nævus pigmentosus, Lentigo, and Chloasma.

Those of *deficiency* are Albinism and Leucoderma.

Pathology.—Pigmentation of the skin may be derived either from the colouring-matter of the blood, extravasated or exuded into the tissues, and is then only an exaggeration of a normal process; or from matters introduced into the blood, as bile-pigment producing jaundice; or from without, as arsenic or nitrate of silver; or, again, there may be a local infiltration of the skin, as in tattooing, chrysarobin inunctions, &c. Except where due to local applications, the

pigment is deposited chiefly in the rete mucosum, and almost entirely in the lower layers; it may also be seen in the upper layers of the corium in its passage from the vessels to the rete, to which it is conveyed probably by the branching connective-tissue cells; if these cells atrophy or are absent, the skin of the part is abnormally pale, but the untransferred pigment may be deposited in excess in the surrounding skin, as is seen in leucoderma, which is associated with melanoderma. But little is known of the pathological causes of general pigmentation, but disturbed innervation doubtless plays the chief part. Thus the bronzing of Addison's disease is, in all probability, produced by chronic inflammation of the abdominal sympathetic; while the general pigmentation which occasionally follows severe chills, and the disturbed pigment-distribution of leucoderma, which has in many cases followed closely on sunstroke, must also be regarded as nerve manifestations. Local pigmentation is in the majority of cases the direct consequence of acute or chronic hyperæmia, the blood or its colouring-matter escaping from the vessels and discolouring the tissues. This is especially common on the lower limbs, where the dependent position and frequency of varicose veins favour the exudation; the orange-coloured patches, for instance, seen on the leg being the direct consequence of capillary rupture.

Variations occur in colour, duration, and extent. In colour, pigmentation derived from the colouring-matter of the blood varies from a dull yellow or olive to brown or black. It is of a bright yellow or olive when due to bile, and a slate colour from nitrate of silver. It may be temporary as a sequel of skin-eruption and in jaundice, or permanent as in argyria. In extent, pigmentation may be general as in Addison's disease, in small spots as in lentigo, or in large patches as in chloasma.

Absence of pigment may also be general as in albinism, or partial as in leucoderma.

Ætiology.—Acquired pigmentation may be idiopathic or symptomatic.

Idiopathic pigmentations comprise those due to local causes, such as irritants, including blisters, sinapisms, friction, pressure, scratching, heat, or sun exposure.

Symptomatic pigmentations may be (1) *general*, as in Addison's disease, Graves's disease, leprosy, syphilis, malaria, cancer, tuberculosis, senile degeneration of the skin, argyria, and arsenical pigmentation. (2) *local*—(*a*) as a sequela of certain skin-eruptions, such as syphilides, lichen planus, some forms of urticaria; (*b*) an accompanying manifestation of certain skin-lesions, such as scleroderma, diffuse or circumscribed, and fibroma; (*c*) due to parasitic affections, as in tinea cruris, tinea versicolor, erythrasma, and the Pinta disease of Mexico. In these, however, the discoloration is on the skin, or at most only in the surface layers.

On the legs especially, if varicose veins are present, anything which produces hyperæmia is liable to stain the skin.

1. Nævus Pigmentosus.—Synon.: Pigmentary Mole; Fr. *Nævus Pigmentaire*; Ger. *Fleckenmal.*

Moles are congenital structures which may be mere collections of pigment (*nævus spilus* or *congenital lentigo*); or the surface may be uneven and warty (*nævus verrucosus*); or the pigment may be in soft tumours of fat and loose connective tissue (*nævus lipomatodes*); or the tumours may be covered with coarse hair (*nævus pilosus*). They vary infinitely in colour, number, size, and distribution, sometimes occupying a nerve-area. Later in life they sometimes become the seat of sarcoma or other malignant neoplasm.

Treatment.—Small tumours or hairy moles are best destroyed by electrolysis, both hair and tumour being removed by this method, each hair being separately attacked. Larger tumours, where not too large, and when their position renders it advisable, should be removed by the knife or caustics. In elderly people, any active change in a mole should be the signal for instant and complete removal.

2. Lentigo.—Synon.: Freckles; *Ephelides*; Fr. *Lentigo*; Ger. *Sommersprosse.*

This affection consists of small spots of pigment, from a pin's head to a split pea in area, and of a yellow, yellowish brown, or sepia tint. They occur chiefly on uncovered parts, namely, the face, neck, and back of the hands; less frequently on covered parts, chiefly the arms, back, and buttocks. They are usually in large numbers, more thickly aggregated in some parts than others, for example, on the nose and cheeks. Occasionally a few large pea-sized spots may be sparsely scattered about, with or without the smaller variety. Although seen at all ages, the ordinary freckles appear most commonly in the second decade of life, especially in fair or red-haired people, showing first in summer, when they are always most conspicuous, while in winter they may be scarcely noticeable. The sun is probably the exciting agent of these summer freckles, and some authors restrict the term 'ephelides' to them, reserving the term 'lentigo' for the spots which come in covered parts and are independent of season. Lentigines may be a symptomatic condition, as in xeroderma pigmentosum, and as one manifestation of senile degeneration of the skin. On the other hand, they are occasionally congenital, and are then classed with moles.

3. Chloasma.—Chloasma is a generic term for both patchy and diffuse pigmentation, but is chiefly used for the patchy form.

The patches are well defined, sometimes roundish or oval, but they may be of any shape

or size, and any shade from fawn to brown, bronze, or black. When diffuse, the colour is always of deeper hue in some regions than others, namely, the axillæ, nipples, umbilicus, pubes, and genitalia. The causation has been discussed in the general ætiology of pigmentation. The most important variety is *chloasma uterinum* of women who are pregnant, or who suffer from chronic uterine irritation. Its most common positions are the linea alba, nipples, and forehead; but it may come in any part of the face. On the forehead it forms one or more irregular patches, but in other parts it is less defined. It usually fades slowly after parturition, but is occasionally persistent. A similar pigmentation of the face has been observed in abdominal tuberculosis, cirrhosis of the liver, constipation, and cancer of the stomach.

Diagnosis.—Chloasma may be distinguished from discolorations due to vegetable parasites by the latter being on rather than in the skin, except in the surface layers. If there is any doubt, scrapings of the epidermis, soaked in liquor potassæ and placed under the microscope, will show the fungous elements if the discoloration is due to a parasite.

Accidental or malingering pigmentation can be washed off either with soap and water or with weak chlorinated lime solution. Chromidrosis deposit can be readily removed with spirit of chloroform or ether.

Prognosis.—Time generally removes pigmentation due to previous eruptions and that due to pregnancy. The duration and continued activity of the cause are the chief factors in determining the likelihood of the removal of the discoloration.

Treatment.—This is not very satisfactory, either for lentigo or chloasma. Sometimes discutients are effectual, but in a large proportion of cases their action is only temporary. From a half to 5 grains of corrosive sublimate, but not more than 2 grains to begin with, may be added to a fluid ounce of almond emulsion, and this painted on several times a day; and if well borne the stronger solution may be used. Other well-approved applications are acetic acid and sulphur made into a paste, and laid on; citric acid (ʒss. to ℥j. of water); pure carbolic acid very carefully applied with a brush; or salicylic acid made into a paste with glycerine. These should all be used cautiously over a small surface at a time at first, as occasionally in strongly predisposed persons the pigmentation returns worse than before.

4. **Argyria.**—Argyria is the term applied to the staining produced by the long-continued administration of nitrate of silver, either internally as a remedy for epilepsy or other diseases, or as a topical application to the throat. The reduced metal is deposited in the rete and sweat-glands, and round the hair-roots. It is said that 450 grains is the minimum quantity taken internally which has produced the staining; but it is wise to be well within this limit, as, when once it has commenced to show itself, nothing will stop its further development or remove it afterwards. The parts exposed to light, the face, hands, and visible mucous membranes, are most strongly implicated. The colour is of a bluish-grey, slate, or leaden hue, or it may be almost black. Iodide of potassium in large doses has been recommended, but all treatment is unavailing.

5. **Arsenical Pigmentation.**—This is due to the deposition of the metal in the skin from prolonged administration of arsenious acid. It is general, but attacks most the parts where diffuse pigmentation is usually most marked. At first it may be recognisable by its sparing the central parts of the hair-follicles, so that on the abdomen there are whitish dots on a yellowish-brown ground, but at a later stage the discoloration is uniform. It may be accompanied by keratosis of the palms, soles, elbows, knees, knuckles, and web of the fingers. When psoriasis has been removed by the administration of arsenic, the site of the psoriasis patches may be the only parts pigmented. If the drug is stopped, the pigmentation usually fades in the course of time.

6. **Albinism.**—This disorder of pigmentation is described in a special article. *See* Albinism.

7. **Leucoderma.** — Synon.: *Vitiligo*; *Leucopathia*.

This disease is much more frequent in tropical than in temperate climates. It is a mixed condition of faulty pigment-distribution, but is named from its most conspicuous feature. It is notably symmetrical. Its first stage, though often overlooked, is an increase of pigment in certain regions; in this darker area, a white spot forms and enlarges, driving, so to speak, the pigment before it, so that the borders of the white part are convex, and those of the adjacent over-pigmented part concave. The dark part is sharply defined on the white side, while away from the white area it merges gradually into the normal skin. The number and extent of the white areas vary considerably, but the affection may in course of years affect the whole surface, the white part ever encroaching on the dark; or the excess of pigment may be absorbed. In either case, in some regions, or even over the whole surface, an apparent cure is produced in white races from want of contrast, but the part is really abnormally white, and will no longer tan in the sun.

Ætiology.—The affection is certainly more common in dark races, and is generally connected with sun exposure, some cases dating from sunstroke; but it has occurred after severe cold. The neurotic temperament and nerve-depressing influences appear to be favouring conditions. The pathology of the

process has been discussed in the general statement.

Diagnosis.—Its striking symmetry, progressive course, and the combination of excess with deficiency of pigment, together with the absence of all symptoms other than the pigment anomaly, render the diagnosis of leucoderma easy. The last feature is important, as in India the disease has sometimes been called 'white leprosy.'

Prognosis.—The prospect of cure is bad; spontaneous arrest occurs; but apparent cure by the process previously described is the result to be most desired.

Treatment.—This is highly unsatisfactory. General tonic and invigorating treatment offers the best chance of arresting the progress of disease; and, of course, arsenic is recommended by some authors. White areas in a conspicuous position might be slightly stained with walnut-juice to render the contrast less striking.

H. Radcliffe Crocker.

PIGMENTATION, MORBID.—Definition.—A morbid process, consisting in the deposition of colouring matter in situations where it does not normally occur, or in excess in usual localities.

Description.—The abnormal deposition of pigment may take the form of an uniform staining of the tissues, as in icterus; or it may occur in patches, varying from mere specks up to areas of a very considerable size. The coloration may affect the skin (*see* Pigmentary Diseases of the Skin) or the mucous membrane, as in Addison's disease, where patches of pigmentation are frequently seen on the palate and inside of the cheeks, and occasionally on the surface of the intestine; or the pigment may be deposited in granular masses in the substance of organs, such as the liver, brain, spleen, kidneys, lymphatic glands, and medulla of bones. New-growths, of the epithelial and, more especially, of the connective-tissue type, may be the seat of extensive pigmentation, especially if the tissues with which they are connected be normally the repositories of colouring matter; but the change is by no means limited to such situations. Chronic inflammatory tissue—notably the peritoneal—is usually much pigmented, from a grey or slate colour to almost black.

Considerable variety is presented in colour. The various shades of black and brown are usually attributed to the existence of a substance called 'melanin,' though there is reason to believe that several different pigments are included under this term. In chemical composition melanin contains carbon, hydrogen, nitrogen, oxygen, and iron; in this latter respect resembling hæmatin. It is soluble in ether, alcohol, water, and acids; also in boiling caustic alkalis, thus distinguishing it from particles of carbon.

The bile-pigments are obviously the cause of icteric staining. The very exceptional and remarkable condition of *cyanoderma* is attributed to the presence of indigo. The excessive ingestion of lead is liable to be followed by a bluish line around the gums; of silver, by a peculiar coloration of the skin (argyria). Iron, mercury, and bismuth in the intestine are converted into black sulphides, and may form a dark precipitate on the mucous membrane.

Pathology.—Excepting when the colouring matters are obviously introduced from without, the morbid, like the normal pigments, are derived more or less directly from the hæmoglobin of the blood, occurring either as stainings of various tints, from decomposition of effused blood, or as the result of cell-activity, as is the case in melanosis. Their presence is associated with two very opposite conditions of nutrition, being sometimes an accompaniment of tissue-degeneration and diminished function, at other times connected with extremely active trophic changes. It is noticeable that the chlorophyll of plants and hæmoglobin of blood are amongst the earliest differentiated and most widely distributed proximate principles, intimately dependent upon which are the respiratory changes of plants and animals. The pigmentary layer of the retina, the visual purple, and the widespread occurrence of pigment in the nerve-centres, are among the most striking examples of the connexion of colouring matter with normal functional changes. Melanotic growths, which are usually of remarkable activity, the temporary brown patches on the skin (*melasma*) in the neighbourhood of painful spots in neuralgia and some uterine states, and the occasional sudden loss of colour in the hair from mental disturbance, are illustrations of morbid nutrition in the same direction. In the majority of cases where pigment is met with, some coincident blood-change is to be found. Thus in the class of malarial diseases, masses of black material are formed in the blood (*melanæmia*), from destruction of the red corpuscles during the pyrexial state, and are liable to be deposited, it is said, by the white corpuscles, in certain organs, especially the spleen. In Addison's disease, purpura, syphilis, and other diseases characterised by pigmentation, the red corpuscles are obviously affected. The deposition of pigment appears without doubt to be somehow under the control of the sympathetic centres.

Dr. Laycock observes: 'Fundamentally, the entire series of phenomena in which pigmentation is a leading characteristic may be regarded as having reference to the excretion of carbon after it has served its purpose in the economy; and, pathologically, the production of pigments may be taken as the expression of—(*a*) imperfect oxidation of carbon, so that it is not eliminated, as carbonic

or lactic acids, &c.; (*b*) imperfect elimination of carbon proper; and (*c*) excessive production of carbon from highly carbonaceous foods. In all these there is a close analogy between the carbonaceous excreta as morbid pigments, and the nitrogenous excreta as morbid deposits of urates, &c.' However that may be, all diseases in which the red corpuscles are altered and their oxygen-carrying power diminished, tend to be associated with pigmentation, from imperfect oxidation of the carbon-waste.

A spurious pigmentation or blackish coloration by sulphide of iron is to be met with *post mortem*, or in gangrenous areas, from the union of sulphuretted hydrogen with the iron of the blood. W. H. ALLCHIN.

PILES.—A popular name for hæmorrhoids. *See* HÆMORRHOIDS.

PIMPLES.—A popular name for papules. *See* PAPULA.

PISA, in Central Italy.—A rather moist, mild, equable, calm, and relaxing climate. Mean temperature, winter, 44° F. East prevailing wind. *See* CLIMATE, Treatment of Disease by.

PITTING.—The formation of pits or hollow cicatrices in the skin, resulting from ulceration, as in small-pox; or from disorganisation of tissue and absorption of the papillary layer of the skin, as in syphilis and lupus. Also, the depression produced by pressure on an œdematous part.

PITUITOUS (*pituita*, phlegm; from root of *spuo*, I spit).—A term associated with phlegm or expectoration, when this is of the nature of thick and adhesive mucus. *See* EXPECTORATION; and SPUTUM, Examination of.

PITYRIASIS (*πίτυρον*, bran).—SYNON.: Furfur; Porrigo; Fr. *Pityriasis*; Ger. *Kleiengrind.*

DEFINITION.—A branny exfoliation of the skin; giving rise to scurfiness or scaliness of the epidermis.

ANATOMICAL CHARACTERS.—Pityriasis is a superficial chronic inflammation of the skin, without exudation or swelling, but especially characterised by disturbed nutrition of the epidermis and its desquamation in minute scales. In many cases it is a mild manifestation of eczema, and must be regarded as one of the forms of dry eczema.

DESCRIPTION.—The most common seat of pityriasis is the scalp—for example, *P. capitis*; and in that situation it may present several degrees of severity, ranging between the pityriasis with silvery scales of olderly persons (*xerasia*), or the mere accumulation of epidermic exuviæ in children and young persons, called 'dandruff,' and the more extensive desquamation, attended with chronic inflammation, of a declining eczema or even of psoriasis.

On the sensitive skin of children, particularly those of light complexion, pityriasis is apt to appear on the face in the form of small, circular, reddish discs, coated over with a fine furfur; and occasionally it is met with in patches on the body and limbs, always maintaining the same characters, namely, slight redness and pruritus, but a total absence of serous exudation.

The term 'pityriasis,' whilst strictly signifying an exfoliation of fine scales upon a skin more or less congested yet falling short of the activity of eczema, has also been applied to a furfuraceous state of the skin accompanying other morbid affections of this texture. Another form of exfoliation of the epidermis associated with a yellowish pigmentation of the skin, received from Willan the name of *pityriasis versicolor*; but as the pathological conditions of the latter are totally different from ordinary pityriasis, and are identical with parasitic diseases, this affection will be found treated of under the head of TINEA VERSICOLOR.

DIAGNOSIS.—The description just given of pityriasis will sufficiently distinguish it from other diseases; although, as will be perceived, it may be an accidental accompaniment of a variety of cutaneous affections, such as dry chronic eczema. Indeed, its idiopathic form is its rarest manifestation.

TREATMENT.—Our efforts in this direction should be aimed at the improvement of the nutritive function of the skin, and the relief of local inconvenience or suffering. The first indication is to be met by general tonics, and by the exhibition of small doses of some arsenical preparation; the second indication by the application of the red oxide of mercury ointment in a diluted form (one part to three), or the oxide of zinc ointment. The former remedy is the more suitable for the scalp or hairy regions of the body; the latter for the unprotected surface of the face and trunk. ERASMUS WILSON.

PITYRIASIS ROSEA.—SYNON.: *Pityriasis Circinata et Maculata*; *Herpes Tonsurans Maculosus* (Hebra).

DEFINITION.—An acute inflammatory eruption, characterised by the formation of pale red, delicately scaly, roundish, or oval patches and circles.

ÆTIOLOGY.—Pityriasis rosea is uncommon, about one in three hundred of all skin eruptions. It is more frequent in children, though it may be seen at all ages. It occasionally occurs in more than one member of a family, suggesting a possibility of contagion, but there is no definite proof that the complaint can be so transmitted.

DESCRIPTION.—There are two forms of the eruption, the *maculate* and the *circinate.*

Pityriasis rosea maculata consists of

roundish, oval, or irregular pale red patches, from a pin's head to a shilling in size, with well-defined borders, and the surface more or less covered with very fine delicate scales.

Pityriasis rosea circinata, as its name implies, occurs in circles. These commence as patches, and, as they enlarge, clear in the centre, which is left slightly pigmented, while the border is well defined and slightly scaly. When they meet other patches, gyrate areas are produced. In both forms, the eruption generally commences as a single patch, and after some days others form in the neighbourhood; the abdomen, chest, or side of the neck being the regions usually first affected. From one of these parts the eruption spreads, the old part usually clearing away, leaving slight pigmentation, while fresh patches develop, so that in the course of days or weeks the whole body-surface may become involved, and all stages of progression and retrogression may be simultaneously observed in different regions. There may be slight itching when the patient is warm. The disease tends to get well spontaneously, lasting from two weeks to two months, occasionally longer.

Pathology.—The pathology is unknown. The 'microsporon anomœon,' described by Vidal as a fungus (? micrococcus), has not been proved to be the cause of the affection.

Diagnosis.—The pale red, slightly scaly, barely elevated patches or circles, covering a wide area, and undergoing spontaneous cure, are the most distinctive features of this disease. It is much less raised, and less scaly, than the early scaly or circinate syphilide; has no scaly crusts, but only delicate branny scales; and is not so red or so raised as psoriasis. It spreads too rapidly and widely for tinea circinata; and there is, of course, no trichophyton tonsurans fungus. It is not, like lichen circinatus or seborrhœa corporis, confined to the middle of the back and chest, and is never in papular circles; moreover, while that affection lasts for years if untreated, pityriasis rosea gets well in a few weeks or months.

Treatment.—Internal treatment is not required. A lotion consisting of liquor carbonis detergens, ʒij. to ℥viij. of water, is useful in allaying itching, and is perhaps curative. At all events, cases soon get well while using it. If the patient is seen when there are only one or two patches present, these may be painted with tincture of iodine.

H. Radcliffe Crocker.

PITYRIASIS RUBRA

PITYRIASIS RUBRA (πίτυρον, bran; *ruber*, red).—Synon.: *Dermatitis Exfoliativa*; *Eczema Foliaceum*; Fr. *Herpétides Exfoliatives*; *Erythrodermie Exfoliante*; Ger. *Hautkleie.*

Definition.—An extensive and important natural group of skin-affections, in which there is universal, or almost universal, dermatitis; generally very chronic in its course; characterised by the severity of the congestion and the intense redness of the parts affected, and by the abundance of desquamation, either in the form of fine branny dust, or of large scales or sheets of epithelium.

The term is not applicable to a somewhat similar condition, which may be caused by the exanthemata (especially scarlatina, erysipelas, Rötheln and measles), or by certain drugs (for example, chloral hydrate, belladonna, quinine, copaiba, and phenazone).

Ætiology.—The causes of pityriasis rubra are very obscure. It occurs more frequently in the male than in the female sex, in the proportion of three to two, or perhaps higher. It is most commonly met with between the ages of forty and sixty years, but has been observed in a child of four months, and in a man of ninety years. It is not hereditary. Nor is it contagious; but a condition indistinguishable from pityriasis rubra as regards its objective characters has lately prevailed in an epidemic form, especially in the infirmaries and workhouses of the west end of London. Gout, and still more rheumatism, strongly predispose to its occurrence, either as a primary dermatosis or as an epi-phenomenon of other skin diseases; and the same remark applies to chronic alcoholism and interstitial nephritis in a less degree. Its 'secondary' form may supervene upon psoriasis or—in diminishing grade of frequency—upon eczema, lichen ruber, erysipelas, seborrhœa, erythema multiforme, pityriasis rosea, or even artificial dermatitis, for example, from chrysarobin.

The most frequent immediate exciting cause of pityriasis rubra is a chill, while the subjects of it are frequently neurotic and intensely susceptible to cold, with other evidences of ill-balanced peripheral circulation. Severe nerve shock and mental strain seem mainly responsible for a certain number of cases. In a very remarkable example under the writer's observation, the condition showed itself immediately after an extremely prolonged cross-examination in the witness-box at the hands of an eminent, but notoriously harassing, counsel.

Anatomical Characters.—These are in no sense characteristic. They include marked congestion and dilatation of the blood-vessels of the most superficial parts of the skin, and comparatively little of those of the deeper parts; separation of the upper two-thirds from the lower third of the horny layer; thinning of the Malpighian layer over the papillæ, with great increase in size and depth of the inter-papillary processes; marked hypertrophy of the papillæ, with intense leucocytic infiltration of them, and of the upper layers of the corium. In a later stage the whole thickness of the skin is involved, and ultimately a process of sclerosis takes place, with formation of cicatricial tissue, pigmentation, and destruction of sebaceous and sweat glands.

Symptoms.—From the foregoing definition it will be manifest that a large number of maladies present the common characters attributed to pityriasis rubra, the synonym for which (*dermatitis exfoliativa*) is now in habitual use to connote the condition, both in this country and on the Continent.

Type I. *Secondary pityriasis rubra.—Generalised red and desquamative eruptions secondary to other dermatoses* (herpétides exfoliatives—Bazin).

The diseases upon which this condition may supervene have already been enumerated. In the case of eczema, discharge diminishes, and small, dry, whitish scales form in increasing numbers. The scaling of psoriasis becomes finer, while the margins of its patches usually become more and more ill defined, although in one case observed by the writer blebs formed round them. The bullæ of pemphigus become flaccid, and resemble the lesions of pemphigus foliaceus. Gradually from the primarily affected parts the erythrodermia spreads over the whole body-surface, which becomes covered with fine branny scales, the feet and soles being the parts most frequently spared. The nails become hypertrophied and claw-like, or may be shed and repeatedly re-formed. The general condition is usually maintained, the appetite and digestive functions being unimpaired; but occasionally marasmus sets in, albumen appears in the urine, severe diarrhœa or pneumonia supervenes, and the case terminates fatally. In the great majority of cases, however, spontaneous recovery ensues in from six to twelve months after the occurrence of an indefinite number of relapses. The primary skin-trouble often reappears, and each recurrence is prone to be followed by a generalised exfoliative dermatitis of gradually increasing severity.

Type II. *The relapsing, desquamative, scarlatiniform erythema* of Féréol represents the mildest form of primary exfoliative dermatitis. It is little known in this country, but the writer has seen at least one well-marked instance of it. It is of more frequent occurrence in children and young adults than the other types. Its onset is well defined, with pyrexia (102°–104°) and general malaise, sometimes even with sore-throat, and a desquamating, scarlatinal-looking tongue. The eruption does not usually make its appearance for two or three days. It consists of an intense, more or less uniform redness, sometimes with small purpuric spots, but without any infiltration; its commonest situation is the legs, from which it spreads over the whole body. After its persistence for three or four days, copious fine or coarse desquamation sets in, fever diminishes, and the redness begins to subside. At the end of a fortnight recovery is sometimes complete, but more generally repeated recrudescences prolong the duration of the disease over six weeks or two months. An accurate diagnosis in a first attack can only be a matter of surmise, but the subsequent course of the disease renders its nature indubitable. Relapses, presenting the characters of the first attack, invariably occur, and generally at regular seasonal intervals, most commonly in spring, when the return is usually attributable to a chill. With each relapse the severity of the disease tends to diminish, and finally perfect recovery generally takes place. It appears that sometimes the ingestion of certain drugs (especially mercurials) or the application of irritants (blisters, &c.) to the skin is responsible for the initial attack, which may be followed by relapses in the manner described. The disease is not infectious, and does not occur in epidemics; it is not accompanied by albuminuria, and loss of hair is very exceptional. A transverse groove on each nail is, however, generally left by each attack, while in the most severe cases the nails may be shed. This brings the disease into close relationship with—

Type III. *The primary universal exfoliative dermatitis* of Erasmus Wilson, which is a less rare and more severe affection than the foregoing. Its objective characters may, in exceptional instances, be perfectly copied by cases of secondary exfoliative dermatitis, but the differences in clinical history and in their *usual* course justify their differentiation. As a rule, the subject attacked is a healthy adult male. The onset is acute, with rigors or chills, or may be insidious and accompanied merely by 'malaise.' The temperature rises to 102° F. or higher; and until the eruption is on the wane it generally remains above the normal, with a marked evening rise. The eruption usually appears in the form of red erythematous patches, with fine desquamation, situated on the trunk, but it rapidly spreads, to become generalised over the whole body-surface. The skin is of an intense bright-red colour, but if exposed to cold often becomes of a dusky blue; in severe cases it is somewhat infiltrated, hard, and stretched. Soon the epidermis begins to exfoliate, and copious branny scales form and fall from the face, head, and neck; while large papery flakes are shed from the trunk, or remain attached by their centres, while overlapping like slates at their margins. Two or three pints of such scales may be shed in the twenty-four hours. The skin of the palms and soles is usually detached *en masse*, and the redness there does not show itself until after the first exfoliation. The amount of itching varies within wide limits; generally it is severe, and sometimes it precedes the rash, drawing the patient's attention in the first place to it. Sometimes, however, itching is conspicuous by its absence, and the subjective symptoms most commonly complained of are either tenderness or a sense of burning,

while a feeling of cold is experienced by the patient as soon as he is exposed. Oozing from the flexures of the knees, elbows, axillæ, and thighs sometimes occurs, and is often no doubt attributable, in part at least, to rubbing or scratching of the part. In a few very exceptional cases, bullæ have been observed in these situations, allying the disease, according to some writers, with pemphigus foliaceus. The skin over the rest of the body remains intensely harsh, dry, and scaly, although from time to time copious sweating may occur. The scalp is extremely seborrhœic, while pustules, boils, and 'epidermic cones' surrounding lanugo hairs are of frequent occurrence. The mucous membranes become involved: coryza, conjunctivitis, superficial glossitis, stomatitis, and pharyngitis may be observed; while the occasional occurrence of vomiting and diarrhœa probably indicates implication of the gastric and intestinal mucous membranes. The shedding of nails and loss of hair early in the disease are characteristic of this type; they may occur as early as in the fourth week. In a certain number of cases the general condition remains remarkably good, but in others the appetite is lost, the patient emaciates, and alarming prostration sets in. The appearance of albumen in the urine, or the development of pulmonary troubles or of diarrhœa, may usher in a lethal termination (generally in the third or fourth month); but undoubtedly in the majority of cases ultimate recovery occurs in from six to twelve months, after repeated disappointing recrudescences. As a rule, the redness first diminishes, then the scaling, and the two subside gradually together. But in one very remarkable case observed by the writer, large circular areas of white, normal skin suddenly appeared in the midst of diseased skin, and in the course of a week almost entirely covered the surface. Among complications and sequelæ Brocq enumerates carbuncles, abscesses, phlegmons, deafness, iritis, joint-troubles, cardiac complications, partial paralyses, paraplegia, and mental affections.

Type IV. *The primary, universal, chronic pityriasis rubra* of Hebra is a rarer and more grave disorder than the preceding. Its onset is always gradual, and unaccompanied by fever; it is evidenced by the appearance of dry, scaly, red patches, generally on the trunk, which gradually extend, to become universal after a period of several months or, it may be, years. The colour is usually dusky, and the desquamation is always fine. There is little or no infiltration of the skin. Constant chilliness is complained of, but pruritus is seldom a troublesome symptom. Very gradually the skin becomes infiltrated, hard, brawny, and pigmented; then sclerosed, glossy, yellowish, and stretched over prominent bony points, or contracted round the orifices of the orbits and mouth (ectropion, eversion of lips). Slowly, also, but surely and without intermissions, the hair atrophies and falls out; and the nails become thin and crack, or much thickened and friable. Marasmus sets in after years, and the patient gradually sinks as the result of pulmonary tuberculosis, pneumonia, or diarrhœa. In the later stages ulceration and gangrene may hasten the fatal termination.

Pathology.—Of the intimate pathology of this group of diseases but little is known. Dr. Pye-Smith considers the dermatitis as primary; but there seem to be many valid reasons for considering the condition as essentially a vaso-motor and trophic neurosis, more probably of central than of peripheral origin. The co-existence of myelitis has been noted (Jamieson, Campbell, and Turner), and inflammatory changes in the peripheral nerves have been observed, but these are certainly not constant either in their occurrence, or in their nature when present.

Diagnosis.—This is usually easy; the history of the case, the universality of eruption, the intense redness and dryness of skin without marked infiltration, the absence of discharge, the characters of the desquamation and moderate amount of itching, combined with the grave general condition, all serve to distinguish pityriasis rubra from extensive psoriasis, eczema, or lichen planus. Pemphigus foliaceus may be very hard to eliminate from the diagnosis, but generally its bullæ may be distinguished with their foul-smelling contents; it also occurs more frequently in women than in men. Epidemic exfoliative dermatitis (Savill) most closely simulates this disease; indeed, there seems to be no criterion for differentiating them beyond the history of the presence of an epidemic of the former, and the discovery and constant presence in the blood of persons attacked by it of a diplococcus of supposed specific nature. Dr. Risien Russell, who confirmed Dr. Savill's discovery of this micro-organism, and further investigated it, failed to find it in two cases of pityriasis rubra under the writer's care during the prevalence of the epidemic disease, which were at first considered to be typical examples of it.

Prognosis. — The prognosis may be gathered from the study of any case in the light of the description of the various types given. Particular stress is to be laid upon the state of the appetite and digestion, and the presence or absence of albuminuria, pulmonary complications, and emaciation.

Treatment.—Treatment must be assiduous, and directed both to the local and general condition. The patient must be absolutely confined to bed, even in the mildest cases, and until recovery is complete, as the slightest chill is prone to cause relapse. He ought to lie between blankets,

and on a spring-mattress or water-bed. The diet must be nutritious but simple, including milk, in as large quantity as possible, eggs, milk-puddings, strong meat-soups or jellies. Alcohol ought not to be prescribed, unless the prostrated condition of the patient demands it; and then sound wine is preferable to spirits, as causing less thirst and gastric disturbance. Cod-liver oil is sometimes of use when emaciation is marked. Iron appears sometimes to be detrimental, but quinine in an effervescing citrate of potassium mixture is certainly sometimes useful and grateful to the patient. Diuretics, such as acetate of potassium with digitalis, are frequently employed and probably beneficial. The promotion of free diaphoresis by jaborandi or the subcutaneous injection of nitrate of pilocarpine has been advocated by Dr. Stephen Mackenzie and others. Linseed oil in large quantities both externally and internally has been lauded by Sherwell. The bowels must be carefully regulated, preferably with mineral waters and salines, the latter often profitably combined with the liquid extract of cascara sagrada. There is a general consensus of opinion that arsenic is worse than useless in the earlier stages, while few writers accord it anything but faint praise even in the later. The writer has also been disappointed with the effects of antimony, so highly praised by Jamieson. He has also noticed aggravation of the eruption after the administration of opium, chloral hydrate, belladonna, and cannabis indica, with a view to obtaining sleep.

Oily external applications are certainly the most beneficial. The calamine liniment recommended by Dr. Radcliffe Crocker is an admirable preparation. It is composed thus: Calamine 40 grains; oxide of zinc 2 drachms; olive oil and distilled water, each 1 fluid ounce. The patient may be swathed in rags soaked in this liniment, and slightly warmed if necessary. The pharmacopœial linimentum calcis is also useful, as is a lotion consisting of an ounce of glycerole of lead and glycerine in a pint of water, similarly employed. Pure vaseline is occasionally a valuable substitute.

Prolonged warm baths may be of service in diminishing itching, but are apt to be followed by increase of cutaneous hyperæmia. This risk is materially diminished by the addition of bran (6 lbs.), linseed (1 lb.), gelatine (3 lbs.), or potato starch (1 lb.) to the thirty-gallon bath. The further addition of two or three ounces of borax or bicarbonate of sodium is often advantageous.

Pityriasis Rubra Pilaris (Devergie-Richaud).—The recognition of this rare disease as a definite morbid 'entity' is mainly due to the writings of Dr. Ernest Besnier of Paris. At least one well-defined case has been observed in England by the late Dr. Hilton Fagge, and a model of it is preserved in Guy's Hospital Museum. Although its relationships are probably closer with psoriasis than with any of the forms of pityriasis rubra just described, the name which has been assigned to it justifies its position here, the more so as any form of exfoliative dermatitis may, during process of recovery, closely simulate it. The disease generally begins by desquamating patches on the palms and soles, or by a dry seborrhœa of the scalp, or by a fine scaliness of the face. Its onset is non-febrile, and young persons are often its subjects. Soon the characteristic lesions appear on the limbs or body, in the form of small brownish-red, firm, dry, conical papules surrounding atrophied hairs—'epidermic cones' —and sending little processes into the follicles; they are seldom larger than a millet-seed. Occasionally they become confluent, when they lose their characters, and form yellowish, slightly infiltrated, squamous patches, which may closely resemble psoriasis, especially about the knees and elbows. The primary lesions generally retain their characters on the backs of the first and second phalanges of the fingers and toes, and they are pathognomonic of the disease. Severe seborrhœa capitis is always present, but the hair does not fall. On the contrary, hypertrichosis of the affected parts has been noted in some cases. The nails become enormously hypertrophied and claw-like. The face assumes a peculiar powdered appearance, owing to the dry white scales lying on the reddened skin; and sometimes ectropion results from contraction. The general condition remains good.

Prognosis.—Recovery always takes place, but the duration of the disease is quite indefinite, and apparently uninfluenced by treatment.

Treatment.—Treatment may be conducted on the lines laid down for pityriasis rubra. J. J. Pringle.

PITYRIASIS VERSICOLOR (πίτυρον, bran; and *versicolor*, of changing colour).—A synonym for tinea versicolor. *See* Tinea Versicolor.

PLACENTA, Diseases of.—Synon.: Fr. *Maladies du Placenta*; Ger. *Krankheiten des Mutterkuchens.*—The placenta being the sole medium of vital communication between the mother and fœtus, any deviation from its normal condition, by which its development may be arrested, and its physiological action impaired, must be of serious consequence. Nevertheless, the frequency or importance of placental disease is hardly yet sufficiently recognised.

The principal diseases to which the placenta is subject are: (1) Inflammation; (2) Congestion; (3) Hæmorrhage; (4) Myxoma fibrosum; (5) Vesicular degeneration; (6) Fatty degeneration; (7) Atrophy; (8) Hyper-

trophy; (9) Œdema; and (10) Calcareous deposits.

1. **Placenta, Inflammation of.**—Synon.: Placentitis.—Acute inflammation of the placenta is the cause of those morbid adhesions that may occasion the most serious dangers of parturition, namely, *post-partum* hæmorrhage and inversion of the uterus. Moreover, it sometimes causes the death of the fœtus, by destroying the structural integrity of the placenta. The disease is probably generally syphilitic in its origin.

Symptoms.—The symptoms of placentitis are so obscure that it is oftentimes undetected until after the birth of the child, when we find the placenta adherent. In many cases, however, this disease is attended by constitutional irritation or febrile disturbance of a remittent character. A very usual symptom of placentitis is the return of morning sickness in the later months of pregnancy, together with a persistent dull aching pain, or a sensation of weight and fulness, over the hypogastric or iliac regions. The placental souffle will also be found intensified in sound, or abnormal in some other respect.

Treatment.—The treatment most likely to prove useful in cases of placentitis is a mild alterative course of mercury conjoined with tonics, and followed by iodide of potassium. Severe local pain may be relieved by the use of phenazone or other analgesics. This treatment, if necessary, may be conjoined with leeching over the seat of the hypogastric or inguinal pain, should the application of oleate of mercury with morphine, or of some anodyne liniment, fail to give relief.

2. **Placenta, Congestion of.** — This condition is occasionally met with, and more especially after protracted labours, when its existence is recognised by the placenta being then found engorged with blood, hard and tumefied, its external surface of a deep purple colour, and covered with a raised network of tortuous and congested vessels. Acute congestion, from the sudden engorgement of the placental vessels, may also arise at any period of pregnancy, from general plethora, or the recession of some acute inflammatory disease. It may also be occasioned by the sudden check to the placental circulation from the death of the embryo.

The *diagnosis* between congestion and inflammation of the placenta is practically almost impossible. The *treatment* is the same in both cases.

3. **Placenta, Hæmorrhage into.**—Acute congestion of the placenta generally terminates by hæmorrhage into either the deciduous or cellular (maternal) portion; into the villous or vascular (fœtal) part of this organ; or in some cases into the cellular interspace between these, thus constituting what Cruveilhier described as 'apoplexy of the placenta.' Hæmorrhagic effusions of this kind are a frequent cause of miscarriage.

Occasionally, especially amongst the too frequently ill-treated wives of the labouring classes, placental hæmorrhage is the result of external violence or shock. The effusion then generally takes place from the central external surface of the placenta, which is thus partially separated from the uterus; but if the effusion be limited to a few ounces, gestation may go on undisturbed.

4. **Placental Myxoma Fibrosum.**—Under this name a remarkable morbid transformation of the villi of the placenta has been described by Virchow, and later by Sir William Priestley, who has seen two specimens of this rare condition. According to the latter authority, it is quite different from the cellular or fibrous degeneration of the villi described by Ercolani and Robin, consisting of such enlargement of the stems and villi by fibroid hypertrophy, that they form in some cases distinct tumours in the placental structure. The fibroid change is more frequently connected with the later period of pregnancy, although indications of it are sometimes seen in the earlier months, and therefore it is described as a disease of the fully developed placenta. If the placenta is only partially affected, the child, though emaciated, may live; if the disease is more universal, the child dies.

5. **Placenta, Vesicular Disease of.** Myxoma of the placental chorionic villi, or, as it was formerly termed, hydatidinous disease of the placenta, or vesicular mole, consists in degeneration and abnormal proliferation of the placental villi of the chorion, usually following, although occasionally producing, the death of the fœtus. According to Spiegleberg, degeneration of certain lobes of the placenta in the midst of healthy ones, or partial myxoma occurring in different cotyledons, is also met with; and under such circumstances no injury need result to the fœtus. In the *Transactions of the Royal Academy of Medicine in Ireland*, the writer has related several cases of this comparatively rare disease. In most of these the hydatidiform mass was expelled from the uterus at the fifth month. In some instances, however, the vesicular mole has co-existed with a healthy fœtus to the end of the full term of gestation. *See* Mole; Molar Pregnancy.

Symptoms.—The symptoms of this disease can at first hardly be distinguished from those of ordinary pregnancy. If, however, in addition to the signs that usually denote the death of the fœtus *in utero*, the patient experiences occasional gushes of water, together with slight hæmorrhage from the uterus, lasting for a short time, and recurring at irregular intervals, we may suspect the existence of myxomatous disease in the placenta of a blighted fœtus.

The expulsion of these growths is generally attended by severe hæmorrhage.

Treatment.—In the way of treatment, nothing can be done to arrest the progress of the disease. But an attempt should always be made to prevent its recurrence by improving the general health of the patient by alteratives and ferruginous tonics, especially any of the milder saline chalybeate waters, such as Ems, Kissingen, or Schwalbach.

It has been recommended that we should bring on the expulsion of vesicular moles as soon as they are discovered. This, however, is inadvisable. Only a portion of the placenta may be affected; or, as the writer has seen, the birth of a healthy living child may be followed by the diseased placenta of a blighted twin conception. Hence, we should let nature take her course, for in due time the morbid growth will be surely expelled from the uterus, rather than by unnecessary interference run the risk of destroying a living fœtus.

6. **Placenta, Fatty Degeneration of.**—This is a common disease, so frequent, indeed, in its less marked forms as to have been regarded by Dr. Druitt as a normal condition at the end of pregnancy, and as being then preparatory to detachment at the time of delivery. It may be circumscribed or diffuse resulting from retrograde changes.

7. **Placenta, Atrophy of, or Placental Phthisis.**—Atrophy of the placenta is an occasional cause of the death of the fœtus between the sixth and ninth months of gestation. The uterine placental villi in such cases are arrested in their development, undergoing a retrograde metamorphosis into an opaque molecular substance, generally accompanied by fatty deposits in the terminal vessels of the fœtal portions of the blighted organ.

8. **Placenta, Hypertrophy of.**—This is a less frequent pathological condition than that last mentioned. We sometimes, however, find the placenta greatly enlarged without any apparent alteration in its structure, and in such cases the child, if alive, is usually diminutive and puny, being stunted not only by the blood having been diverted from its nutrition, but still more by the compression of the terminal umbilical vessels.

9. **Placenta, Œdema of.**—Effusion of serum is another occasional consequence of placentitis. In the cases of this kind that the writer has seen, abortion generally occurred, and the placental villi were enormously distended and bloodless, being filled with a serous fluid. In one instance, in addition to dropsy of the placenta, the umbilical cord was œdematous to an extraordinary extent.

10. **Placenta, Calcareous Deposits in.**—Calcareous deposits are frequently met with, more especially in cases of adherent placenta, being usually situated in the external or uterine surface, and in the decidual vessels. In some instances, however, the writer has found these deposits scattered throughout the whole substance of the after-birth, as well as coating its fœtal surface. According to Priestley, they seem particularly prone to develop themselves in any adventitious deposit. The same writer has found them in placentæ of women unusually robust, being then probably the product of a gouty diathesis. Dr. Barnes, on the other hand, associates placental calcareous deposits rather with scrofula, tuberculosis, and poor living, and draws a parallel between such deposits in the placenta and those found in the tubercular lung.

Treatment.—The general treatment of placental disease must necessarily remain largely empirical and unsatisfactory, until the recognition and differential diagnosis during pregnancy of the various placental diseases referred to may be found more practicable. Nevertheless, there are some circumstances commonly connected with placental diseases that will perhaps serve to indicate the general principles of treatment. In the first place, the immediate or proximate cause of all placental disease may be assumed to consist in local inflammatory action, however occasioned. Secondly, their most frequent subjects are patients of strumous diathesis, or who have suffered from syphilitic disease. Thirdly, such placental lesions are specially prone to recurrence in successive pregnancies.

Bearing these facts in mind, the obstetrician, however unable he may be to arrest or even to diagnose existing placental disease, may at least be successful in the prevention of its recurrence by remedying the constitutional condition or cachexia, whether strumous or syphilitic, of its subjects. In the former instance, by attention to the general nutrition and hygienic surroundings of the patient, as well as by anti-strumous remedies, such as the various combinations of iodine and iron, cod-liver oil and malt preparations, and, above all, if possible, by change of air and the use of either natural chalybeates, such as Spa, Schwalbach, Ems, or Kissingen springs, or of the iodated mineral waters, namely, Kreuznach, Schinznach, or Woodhall Spa at their sources. In the still more numerous cases in which the origin of these obscure placental disorders is syphilitic, their treatment should obviously be governed by this consideration, the importance of which, however, is best proved in the prevention of their recurrence. In such cases a long-continued course of perchloride of mercury is efficient, administered in gr. $\frac{1}{24}$ doses in tincture of cinchona bark two or three times a day to both parents for some weeks, or even months, until slight but distinct mercurialisation has been produced, abstention *a coitu* being meanwhile enjoined.

Finally, amongst those methods of treatment to which reference has been already made, as being somewhat empirically applied

to different forms of placental disease, there are two which demand notice in this connexion, the respective utility of each having been sufficiently established. Of these, the first is the administration of chlorate of potassium, which was suggested by the late Sir James Simpson in all cases in which the placenta is partially disabled by disease at any time of pregnancy, but is believed to be most useful in the latter half. The second measure referred to is in the induction of premature labour at a period compatible with the viability of the child, that is to say, after the seventh month, in cases in which in the patient's previous pregnancies the fœtus has perished after that period from placental disease.

THOMAS MORE MADDEN.

PLAGUE (πληγή, *plaga*, a stroke).—SYNON.: The Pest; Inguinal, Bubonic, Glandular, Oriental, Indian, Pali, and Levantine Plague; Oriental Typhus; Septic Pestilence; Fr. *la Peste*; Ger. *die Pest*.

DEFINITION.—A specific fever, attended by bubo of the inguinal or other glands, and occasionally by carbuncles.

HISTORY.—The term *plague* is used by the older historians in two senses: (1) in a general sense, as applicable to the prevalence of diseases accompanied by great mortality, irrespective of their nature; and (2) in a limited sense, as indicating the particular malady defined above. The earliest notice of the disease now designated *plague* is found in a work of Oribasius, the physician to the Emperor Julian (A.D. 361–363). He quotes from Rufus (Alexander) of Ephesus, a writer who lived in the reign of the Emperor Trajan (A.D. 98–117), a passage from which it would appear that plague had been known as an endemic, and occasionally as an epidemic, in Libya (North Africa), Egypt, and Syria, from the end of the third or beginning of the second century before Christ. The first appearance of plague in Europe is referred to the sixth century of the Christian era. In the reign of the Emperor Justinian (A.D. 527–565) the disease underwent a development previously unknown. According to contemporary historians, it broke out in Egypt, explosively, and presently spread thence to the neighbouring countries of Africa and Asia; invaded and extended over the whole of Europe; and became generally disseminated throughout the then known world, causing frightful mortality wherever it showed itself. From this period, it is inferred, plague became established in Europe, being sometimes more, sometimes less prevalent, for the 1300 years following—indeed, until the ninth lustrum of the present century. It must, however, be remembered that though numerous pestilences in Europe are recorded by mediæval chroniclers, there is no sufficient evidence, before the fourteenth century, that they were bubonic plague. The undoubted prevalence of this disease began after the black-death of the fourteenth century.

The great pestilence, most familiarly known as the *black-death*, which swept over the western hemisphere in the fourteenth century, causing an inconceivable mortality, and which has been designated *black plague*, although presenting several of the symptoms of bubonic plague, is held by some epidemiologists to have differed essentially from that disease. The *black-death*, according to these writers, was particularly characterised by a gangrenous inflammation of the respiratory organs, violent fixed pains in the chest, vomiting and spitting of blood, and a horribly offensive and pestiferous breath, which could be perceived at a considerable distance from the patient. Such symptoms distinguished, these writers think, the disease from bubonic plague. Moreover, it is noted that while bubonic plague had had its apparent source in Egypt seven centuries before, black-death, according to contemporary writers, had its origin in Cathay (Northern China), and issued thence to devastate the world. Writers who regard black-death as a different malady from plague, hold that the pestilential manifestation of the disease began and ended with the dreadful outbreak of the fourteenth century, and that the malady has long been extinct.

Other writers consider black-death to have been a modification of bubonic plague. But if this view be accepted, the extraordinary development and remarkable modification which the disease underwent in the fourteenth century stand quite alone in the history of the affection, and constitute phenomena which would have to be regarded as indicative of a secular evolution of morbid changes (*see* PERIODICITY IN DISEASE). This last-named view of the relation between black-death and bubonic plague is not without a present interest. For Hirsch and others believe that the *Máhámari* of Northern India—the *Pali*, or *Indian plague*, as the disease is also termed, which has several times prevailed as a local epidemic since the commencement of the present century, is a disease analogous to the *black-death* of the fourteenth century. [But this special analogy is not recognised by other epidemiologists, and Hirsch himself has considerably modified his views.] Probably these writers would now include the more recently known *Yunnan plague* in the same category.

In the fifteenth century the countries in which plague was habitually present, or recurred at intervals, included Northern Africa, Egypt, Western Arabia, Syria and Palestine, Asia Minor and Mesopotamia, Persia, probably India and China, and Europe generally. Throughout the sixteenth and seventeenth centuries there are almost continuous records, from year to year, of the presence of the disease, in greater or less activity,

within this area of prevalence (Carl Martin, *Petermann's Mittheilungen*, Juli 1879). During the latter half of the seventeenth century a remarkable lessening of the area of prevalence of the disease began to take place. As regards Europe, in the course of the twenty years 1661–1681 plague disappeared from Italy, England, Western Germany, Switzerland, the Netherlands, and Spain. This lessening of area continued throughout the eighteenth century, the number of serious outbreaks of plague also diminishing, two only having occurred in that century—namely, (1) in 1703-13 (involving Turkey, Hungary, Russia, Poland, Austria, Bohemia, and Eastern Germany), and (2) in 1720–22 (Provence). At the close of the first third of the nineteenth century, the area of prevalence of the disease had shrunk to the easternmost part of the Turkish Empire in Europe; and in the year 1841 plague ceased on the Continent altogether.

While this change had been taking place in Europe, a corresponding change had been manifested in the prevalence of the disease in its habitats elsewhere. Before its complete cessation in Europe, plague would appear to have disappeared from Northern Africa (except Egypt), from Mesopotamia, and from Persia; the existence of the disease in Asia Minor, Syria, and Palestine came to an end in 1843; and in the year 1844, with the cessation of the malady in Egypt, plague seemed to have become wholly extinct, and Europe to have got rid of a terror which had harassed it for ages.

It is noteworthy that during the period of the progressive narrowing of the limits within which plague prevailed, and until its disappearance, the disease manifested no abatement of those characteristics, as well in respect to rapidity of course, to the nature of the symptoms, and to its fatality, which had made it the dread of Europe and the Levant. The outbreak of 1665 in London, which preceded the disappearance of the disease from England, and which is known as *The Great Plague of London*; also the outbreak of 1720 in Marseilles, which preceded the disappearance of the disease from France, have become historical from the fatality which accompanied them. Hardly, if at all, less terrible was the outbreak in Moscow in 1770, and the later outbreaks in Turkey, in Syria, and in Egypt. Even at the present day the traveller in Persia and Kurdistan comes upon communities the growth of which has been arrested, and the ruins of villages which have been depopulated, by the ravages of plague earlier in the century.

Notwithstanding the disappearance of plague from its last-frequented haunts, certain epidemiologists, and notably Gavin Milroy in this country, having regard to the long intervals which had occasionally been observed between recurring epidemics of the disease, doubted its cessation. Their doubts were presently confirmed by the re-appearance of the plague in the Levant. This happened in 1853 (nine years after the presumed cessation of the disease in Egypt) in the Assyr country, Western Arabia, on the eastern coast of the Red Sea, where a circumscribed outbreak occurred. Other local outbreaks followed at intervals in different places, in the order and countries here noted :—

1853, the Assyr district, Yemen, Western Arabia; 1858–59, province of Bengazi, Regency of Tripoli, North Africa; 1863, district of Maku, Persian Kurdistan; 1867, the marsh district on the right bank of the Euphrates, south and west of Hillah; 1870–71, Persian Kurdistan, in the district south-east of Lake Urumiah; 1871–73, Yunnan Province, Western China; 1873–74, the marsh district on the left bank of the Euphrates, south of Hillah and the position of ancient Babylon. This outbreak proved to be the beginning of a manifestation of the disease, which in the course of the years 1874–75, 1875–76, and 1876–77, showed itself over an area extending from Bagdad on the north to Suk-e-Sheyukh on the south, and from the banks of the Tigris and Shat-el-Hai on the east to the borders of the Syrian desert on the west. Hillah suffered from this outbreak in 1876 (recorded deaths 1,007), and Bagdad, both in 1876 (recorded deaths 2,611) and 1877 (recorded deaths 1,672). The outbreak of 1873–1874 on the Lower Euphrates was not the only appearance of plague at that period. Two other outbreaks occurred in 1874, one in the Assyr district, Western Arabia (the scene of the outbreak of 1853), and another in the province of Bengazi, Regency of Tripoli (the scene of the outbreak of 1858–59). In 1876, in addition to the then prevalence of the disease in the district south of Bagdad and on the Lower Euphrates, plague broke out in the Shuster-Dizful district, Khuzistan, south-eastern Persia; and before the close of the year it had shown itself also in two villages of northern Persia, situated about twenty-five leagues from the south-eastern angle of the Caspian Sea. The same year also there was an outbreak of *Mâhâmari* in the mountainous district of Kumaun, North-western India, which did not terminate until the following year. In 1877 an outbreak occurred at Resht, the capital of the province of Ghilan, Persia, and in the surrounding district. Ghilan lies at the south-west angle of the Caspian Sea. The same year cases of a fatal bubonic febrile malady occurred in the district of Baku, on the Caspian shore of Transcaucasia; and an outbreak of a non-fatal bubonic affection took place in Astrakhan and its vicinage, since recognised as a form of plague. At the beginning of 1878 plague was reported in the district of So-uj-Bulak, Persian Kurdistan; and in October the disease broke out at Vetlianka, a Cossack

settlement on the Lower Volga, in the province of Astrakhan, Russia in Europe, and prevailed there and in the adjacent districts on both banks of the river, until February 1879, with the exception of an isolated case, or more than one, which was observed in the following month.

Since this outbreak, when, after thirty-seven years' absence, plague reappeared on European soil, several epidemics of the disease in its former seats have been recorded. An outbreak causing great mortality occurred on the Lower Euphrates in 1880–81. In 1884 the disease broke out on the Turco-Persian frontier, east of Bagdad, and, as usual, was attributed to an infection derived from Persian Kurdistan. The latter country suffered almost annual epidemics from 1881 to 1885; and, according to recent researches, has been hardly exempt for the last twenty or thirty years. This mountainous district appears to be an endemic seat of the disease; and, as some think, was the source whence the epidemics of Resht and the Caspian basin were derived. Khorassan (a district of Persia proper) suffered in 1877–78 and in 1881; Asterabad in 1886. In 1883–84 there was a doubtful report of a disease resembling plague in Candahar (Afghanistan). No epidemic of *Máhámari* has been recorded in India since 1877, but good authorities believe that the disease is not extinct. In 1879 the disease again showed itself in the Assyr district of Western Arabia; there were rumours of the same in 1887; and a very definite outbreak occurred in 1889. A doubtful epidemic was recently (April 1893) reported from Bengazi in Northern Africa.

Another undoubted seat of endemic plague is the Yunnan district in Southern China, and the seaport of Pakhoi on the Tongking gulf. It is evidently there a soil-disease, causing the death of animals such as rats, dogs, cattle, &c., as well as of men. In Yunnan it is confined to altitudes from 1,200 to 7,200 feet above the sea. Several epidemics since 1871 have been described in the *Reports* of the Imperial Chinese Customs, especially by Manson and Lowry. It shows apparently no tendency to spread into other districts, and foreigners are never affected.

It thus appears that there are at least four localities where plague is still endemic, and may break out at any time in an epidemic, namely: (1) Kurdistan, parts of Persia and the adjacent parts of Turkish Arabia; (2) the Assyr district of Arabia; (3) Bengazi; (4) Yunnan and Pakhoi. None of these, except the last, is without importance as threatening extension into other parts of the Turkish empire, or into the basin of the Mediterranean; and on the whole a certain increase in the activity of the disease since the middle of the century must be recognised.

Ætiology.—Plague is observed to be developed under two principal sets of conditions, namely: (*a*) certain *local states*, physical or social, or both, as the case may be, affecting communities; and (*b*) certain *relations between persons* sick of the disease and healthy persons; to these must be added (*c*) particular *seasonal influences*.

(*a*) The *local conditions* which favour the development of plague were made the subject of careful study by a Commission of the French Academy of Medicine, in 1844. The report of this Commission, prepared by Prus, sums up and represents the then existing knowledge on the subject. According to the Commission, plague was a product of Egypt (where it was held to be endemic), Syria, the two Turkeys (Turkey in Europe and Turkey in Asia), and many other countries of Asia, Africa, and Europe; and the conditions 'which determined and favoured' the development (birth) of the disease among communities there, were—dwelling upon alluvial and marshy soils, notably such as were found near the shores of the Mediterranean, and on the banks of certain great rivers, the Nile, the Euphrates, and the Danube being specified; a warm and humid atmosphere; low, badly ventilated, and crowded houses; great accumulations of putrefying animal and vegetable matters in the vicinity of dwellings; unwholesome and insufficient food; excessive physical and moral misery; and neglect of the laws of health, as well public as private.

The recent appearances of plague have served to correct some and to confirm others of these conclusions of the commission. Plague is no longer endemic in Egypt; but of late years, as already stated, it has broken out in several widely separated places of Africa and Asia. In these outbreaks (excluding from consideration for the present the outbreak in Astrakhan province) the disease appears to have been a local product determined by as yet entirely unknown conditions. The term 'spontaneous' is frequently applied to such developments of disease, but is best avoided as implying more than is warranted by our present knowledge. Again, the recent outbreaks have shown (and Tholozan has particularly dwelt on this subject) that plague is, perhaps, as much a disease of the highlands as of the lowlands. This is evidenced by its persistence in Kumaun, on the Himalayan mountains, and among the mountains in Western Arabia and in Yunnan. The outbreaks in Persian Kurdistan in 1870–71, and in the province of Bengazi in 1873–74, took place on elevated tablelands. The outbreaks also of 1853 and 1874 in Western Arabia took place among the highlands. But, if a less restricted topography must be assigned wherein plague may manifest itself as a local product, so to speak, the later prevalences of the disease confirm fully the conclusions of the Commission of 1844 regarding other conditions of develop-

ment which are not peculiar to any country or locality. The outbreak of 1858–59 in the province of Bengazi followed upon four years' drought and failure of crops, at a time when the greater part of the flocks and herds had been destroyed from want of food, and by a fatal epizootic which prevailed among them, plague breaking out when the population was suffering most from famine, and when the physical and social misery resulting from destitution was greatest. The same was, in effect, the state of things when plague appeared in Maku, in Persian Kurdistan, in 1863; but here it is noted also that the infected district was pervaded with the putrid emanations from the unburied bodies of cattle which had died from murrain. The outbreak of 1867 on the Lower Euphrates was confined to marsh-villages on the right bank of the river; and that of 1873–74, in the same district (the beginning of the greater development of 1874–77), began in marsh-villages on the left bank of the river. The huts of the particular class of villages affected, writes W. H. Colvill, 'are on ground which is a foot or two lower than the surface of the water in spring; and the ground is so saturated with water, that the refuse of the village is neither absorbed nor can it be evaporated, for it acquires fresh moisture from the ground, and this refuse acquires the form of a bluish-black oily fluid which surrounds the huts and covers the paths, and stains the walls two feet from the ground; and, in fact, the village is in such a state of filth that it requires to be seen to be believed.' The outbreaks of 1867 and 1873–74 had been preceded, according to Colvill, by the only two great inundations of the Euphrates which had occurred since 1831, the year of the then latest outbreak of plague in Bagdad. The outbreak of 1870–71 among the highlands of Persian Kurdistan had been preceded by a fatal epizootic among sheep, and ergotism among the people. Writing of one of these mountain-villages—and the account serves for all—Castaldi says: 'Whatever is most afflicting in poverty, whatever is most revolting in filthiness, is accumulated, as if designedly, around these infected dens, in the interior of which live, or rather vegetate, from fifty to sixty men, women, and children. The cultivation of some plots of ground in the neighbourhood furnishes these unfortunates with insufficient nourishment.' The infected district escaped the famine which at this time prevailed in Persia, but it may be a question if the inhabitants escaped severe privation during the winter in which plague first appeared. The outbreak of 1874, in the province of Bengazi, North Africa, occurred among the nomadic tribes occupying the Cyrenaic plateau at a time when some of the favourite Arab camping-grounds had been converted into vast swamps from heavy and protracted rains, and when the people were reduced to the most abject misery and were suffering from an extremity of famine, the result of failure of their crops for three years in succession, consequent on drought. The outbreak of 1876–77 in the mountain-villages of Kumaun took place among communities who are described as occupying houses in which cattle, grain, and families are packed together under conditions of filth not unlike those observed in the mountain-villages of Kurdistan. Of the conditions under which plague was observed in the great towns, as in Bagdad and in Resht, as also on the Volga, they were states of filth, in and about dwellings, such as might be anticipated where no organised scavenging had ever existed, and of crowded and badly ventilated houses. But in Bagdad and the Mesopotamian towns generally, the most influential condition in promoting plague was, according to Colvill and Cabiadis, *poverty*. Cabiadis, indeed, styles the disease, *miseriæ morbus*, thus reproducing, in 1878, a name by which plague was designated by some in the 'Great Visitation' of London, 1665, namely, 'the *Poor's Plague*.' On the other hand, the communities which suffered on the Volga were comparatively prosperous; but, at the time of the appearance of the plague among them, they were living under almost indescribable conditions of filth accumulated about their houses, and from which the interiors were not free.

The local conditions which have been observed to be favourable to the development of plague since the reappearance of the disease in 1853, it will thus be seen, are similar to those which were observed before its disappearance from Europe and the Levant in 1844.

All these insanitary conditions may, however, be observed in many parts of the world where plague has never been heard of. Recent observations upon the origin of plague tend to show that in some at least of its endemic haunts, especially India and China, it is a soil-disease, the virus remaining from year to year, and occasionally under the influence of meteorological or unknown causes becomes epidemic among the population. One evidence is the mortality among animals, such as rats, living underground, often observed in India and China, and occasionally, though rarely, noted in the old European epidemics. Another is the slow progress of the disease, even through crowded cities, as in London in 1665 (*see* the observations of Boghurst, quoted in the article 'Plague,' *Encycl. Brit.*, and more fully in Dr. Creighton's valuable *History of Epidemic Diseases*). Dr. Creighton lays much stress upon cadaveric putrefaction as a factor in producing the disease; but this is not generally accepted. Tholozan has clearly shown that many epidemics in Persia and Arabia were self-limited, and spontaneously came to

an end after spreading over a certain area. Thus the spread of plague from one place to another has a certain analogy to that of cholera, its vitality in a new locality depending upon an infection, perhaps of the soil, or at least of human habitations, more than on personal contagion. As in cholera, too, different epidemics seem to differ immensely in their diffusive power. (On this and other points, *see* Dr. Creighton's work.)

(*b*) That the kind of *relations maintained between persons* sick of plague and the healthy exercised an important influence upon the propagation of the disease, has been made clearly manifest in the recent outbreaks. The more closely and continuously the healthy were brought into association with the sick, the more certain were the former to suffer from the disease. Thus persons living in the same house with the patient were peculiarly liable to suffer, while those who were brought only occasionally into contact with him (as the physician) were rarely affected. And here, again, a difference was noted between the liability of the physicians and of the surgeons and their assistants to be attacked by the disease. The duties of the latter called for more frequent and protracted visits to the patients than the duties of the former, and they suffered to a greater extent. No doubt was entertained that the disease was, in ordinary phrase, *caught* from the sick by the healthy brought into association with them; but there was no certain evidence that actual *contact* with the sick person was necessary to the transmission, as the older doctrine of contagion maintained. On the contrary, the evidence indicated that the transmission was chiefly effected through the healthy breathing the same atmosphere as the sick—that is to say, the atmosphere surrounding the sick person. There would appear to be, in addition, evidence of transmission of the malady by the agency of *clothes and bedding* which had been used by the sick. The newer information obtained on this subject of the transmissibility of plague from those sick of the disease to the healthy, corresponds with the results obtained on the same subject by the Commission of the French Academy in 1844, and both point to a close analogy between the modes of transmission of plague and of typhus, and between the habits of the two infections. In plague, as in typhus, the liability of the healthy to contract the disease is mainly dependent on the constancy and intimacy of communication with the sick. In plague, as in typhus, the danger of infection appears to be principally proportionate to the fouling of the atmosphere surrounding the sick by the effluvium from his body and breath; and in like manner either infection would seem to be peculiarly easy of destruction by free dilution with air. Again, there seems to be no trustworthy evidence to show that the danger of the propagation of plague by *fomites* (as the older writers have it), that is to say, by articles carrying the infection of the disease—such as clothing and bedding—is greater in plague than in typhus. The condition for infection of articles of clothing and bedding was their very intimate use by, or association with, the sick. Evidence was entirely wanting of articles other than those mentioned, and under other conditions, being capable of communicating the disease to the healthy; nor was there anything to confirm the assumption that the long array of articles contained in quarantine-regulations regarding plague were capable of retaining and conveying the infection.

(*c*) Both the sets of conditions here noted as affecting the development of plague appear to be influenced by *seasonal* changes. In Mesopotamia the disease, during its prevalence there, rapidly declines, and becomes dormant, with the setting-in of the hot weather in June (beginning to fall when the temperature reaches 86° F., and ceasing abruptly at 113° F.), its activity re-awakening in winter, and gathering force with the advancing spring. Similar phenomena were observed in Egypt, whilst the disease prevailed in that country. In Constantinople, on the contrary, the disease was dormant during the colder months of the year and became active during the hotter. The same was true of this country when the disease existed here, as is particularly observed in the season of prevalence of the epidemics which have ravaged the metropolis. Here, as William Farr, Edward Smith, and, more recently, Buchan and Mitchell, have shown, from the records of mortality, September was the month of greatest prevalence, the disease rising throughout July and August, and falling throughout October and November. Farther north (in Moscow, for example) the disease has prevailed as severely in the depth of winter as in the height of summer.

Age.—Dr. Cabiadis noted the ages of 1,826 cases of plague observed at Hillah in 1876, with the following result:—

From 2 months to 9 years . .	277
„ 10 years to 19 „ . .	617
„ 20 „ 29 „ . .	432
„ 30 „ 39 „ . .	292
„ 40 „ 49 „ . .	123
„ 50 „ 59 „ . .	52
„ 60 „ 69 „ . .	18
„ 70 „ 79 „ . .	11
„ 80 „ 89 „ . .	3
An old man of 113 (?) „ . .	1
Total . . .	1,826

Incubation.—The recent outbreaks have not furnished much additional information on this subject, but, such as it is, it tends to confirm the conclusion of the Commission of the French Academy. This was to the effect that the disease had never shown itself

among compromised persons after an isolation of eight days. L. Arnaud carefully studied the question in the outbreak of 1874, in the province of Bengazi, and from the facts he then collected concluded that the mean time of incubation of plague was five or six days, and that the maximum duration did not exceed eight days. Hirsch, from the information he obtained at Vetlianka, relating to the recent outbreak in the province of Astrakhan, concluded that the minimum period of incubation observed there was from two to three days, the maximum not exceeding eight days, and that the average might be set down at five days. He notes, however, that very short or very long periods of incubation were seldom observed.

Anatomical Characters.—The recent outbreaks of plague have added nothing to our knowledge of the anatomical characters of the disease. They occurred under circumstances where anatomical investigation was out of the question. The information existing on this subject was obtained almost solely at the time of the French expedition into Egypt at the close of the last century and the beginning of the present; during the outbreaks of plague in Bessarabia, 1825, and in Moldavia and Wallachia, 1828-29; and again in the outbreak of 1834-35 in Egypt. The morbid alterations noted were ecchymoses of the coverings of the nervous centres, of the pericardium, the omentum, and the peritoneum; enlargement and softening of the spleen; punctated extravasations of blood in the mucous membrane of the stomach; ecchymotic spots in the mucous membrane of the intestines; reddish-black injection of the mesenteric glands; extravasation of blood—sometimes considerable—into the cellular tissue about the kidneys, the kidneys themselves being tumefied and presenting extravasation of blood in their tissue and in their pelves. The most constant and characteristic changes were observed in the lymphatic glands. When buboes had been formed, the glands presented manifest signs of inflammatory action in various degrees, as did also at times the surrounding cellular tissue, which was, moreover, frequently the seat of bloody extravasations. The glands of the several cavities were more or less involved in or partook of the morbid action conspicuously observed in the buboes; and even where no buboes had formed, indications of considerable changes were found in the internal lymphatic glands. In some instances the affection of the glands would appear to have been general throughout the body; in others it would be limited to one or more of certain groups, in addition to the more superficial groups, as the bronchial, the mediastinal, the mesenteric, the lumbar, &c. The glands, as a rule, were found more or less enlarged, injected, and infiltrated with sanguineous fluid.

Symptoms.—These are summarised here wholly from the writings of recent observers: W. H. Colvill and Giovanni Cabiadis (as made known by E. D. Dickson) in regard to plague in Mesopotamia; Castaldi, in regard to plague in Mesopotamia, Persian Kurdistan, and Resht; L. Arnaud in regard to plague in Bengazi (*see* Blue Book, *Plague*, 1879); Döppner (official report); Hirsch (*Practitioner*, ii. 1879); and W. H. Colvill and Payne (official report) in regard to plague in the province of Astrakhan. This course is taken, first, because the disease, as they describe it, is that which the present generation is called upon to consider; and, secondly, because, generally speaking, the symptoms observed by them are similar to those described by the earlier writers on the subject.

Plague occurred in three forms in the recent outbreaks, namely, (1) an *abortive* or *larval*; (2) a *grave* (*plague*, as usually understood); and (3) a *fulminant* form.

1. **Abortive (larval) Plague.**—This form is characterised by the appearance of buboes in the groins, armpits, and neck, as a rule painless, and unaccompanied by feverishness. At times, but rarely, the manifestation of the buboes is preceded and accompanied by a general febrile disturbance of the system, so slight as not to preclude the patient from moving about (*ambulatory plague*). At times also a bubo suppurates; but more commonly these swellings disperse in about fourteen days. The buboes are clearly distinguishable from the chronic glandular swellings observed in persons of a scrofulous tendency, or affected with any special diathesis. Cases of abortive plague were recorded in the greater number of the recent outbreaks of the disease of which we have detailed accounts, and were particularly observed preceding and following the outbreak in Mesopotamia in 1873-77, and preceding the outbreak in the province of Astrakhan in 1878-79. It is questionable whether this form of the disease, unaccompanied by any marked febrile disturbance, is infectious.

2. **Plague in its usual form.**—The onset and progress of plague differ much in different cases, and at different periods of an epidemic. Most frequently, after a brief time of lassitude, aching in the limbs and loins (sometimes a very painful aching), and shiverings, a febrile state commences; and concurrently with this, or from the second to the fourth day of its duration, buboes appear in the groins, the armpits, or beneath the angle of the jaw. The febrile state is usually acute, and accompanied with much, often severe, headache, and delirium or stupor; the face being flushed; the eyes red and turbid; the skin hot; the tongue black, dry, and fissured, or coated as with cotton wool, or pointed at the tip, with red edges and thickly furred in the centre; the teeth and gums covered with sordes; and the

thirst intense. The swelling of the glands increases, and is accompanied by much, sometimes acute, pain; and if the patient have lived on, suppuration may take place about the seventh day, at which time, if not earlier, carbuncles or boils may appear. Of these symptoms, or groups of symptoms, it may be noted more particularly that the disease is sometimes ushered in by vertigo, or convulsive tremor, or a peculiar, absent, 'lost' state, when the patient, if he be seized from home, will be observed to make his way thither in a quasi-automatic fashion, with a strange staggering gait; or else, whilst going about his ordinary avocations, he is seen to become distracted, as if impressed with some indefinable fear, which prompts him, if away from his house, to rush wildly through the streets until he reaches it, and then throw himself on the bed in a state of extreme restlessness; while, in the gravest cases, the patient is attacked at the same period with vomiting of blood, and a high febrile state. Cabiadis describes cases ushered in by a *prolonged regular shake*, which persists from six hours to three days, the temperature of the body remaining nearly normal, and the patient not complaining of cold. This *shake* was invariably followed by coma, during which the patient sank rapidly. The pulse, in the febrile state, runs quickly up to 100–130; and the temperature of the body to 102–104°, and in the acutest cases to 107·6° F. The end of the febrile state is marked by a sudden fall of temperature, the thermometer descending sometimes as low as 93·2° F.; at the same time a profuse perspiration often occurs. Heat in the throat and in the epigastrium (in the latter, as of burning charcoal there) was a not infrequent complaint of the patients; and at times a sensation likened to being stabbed by a knife in the breast has occurred. Nausea and vomiting of bilious matters were not uncommon (Arnaud); and vomiting of coffee-ground-looking matter was frequent at the beginning of the outbreak of 1873–74 on the river Euphrates. Constipation is the rule in the acute stages of the disease. It is sometimes followed by diarrhœa, which has been regarded as a favourable sign. No noteworthy change appears to have been observed in the urine, either as to general appearance or quantity, unless it were mingled with blood; but Döppner describes its diminution and even suppression in severe cases at Vetlianka. *Hæmorrhages* were observed from the nose, the lungs, the stomach, the bowels, the vagina, and the urethra; and the cases in which they occurred all ended fatally. Occasionally the respiration is much hurried, but Arnaud states that such disturbances of the respiration as he witnessed in Bengazi were of nervous origin—a nervous dyspnœa preceding death. The prostration is extreme in some cases; and in a few instances in which this was observed, consciousness was maintained until just before the patient expired.

Of the *local signs*, the appearance of the *buboes* not infrequently precedes the symptoms of general disturbance. In some cases they are first observed within seven or eight hours after the febrile state has set in; in other and more numerous cases they show themselves on the second, third, and fourth days of the attack, and rarely on the fifth. When the buboes appear first they are sometimes accidentally discovered, the patient having no previous suspicion that he is affected; but more generally their appearance is preceded by pain in the glandular organs, at times sudden in accession, the patient exclaiming he has been stabbed in the groin, armpit, or elsewhere, as the case might be. The enlarged glands forming buboes are rarely numerous; and of a group only one is, as a rule, conspicuously enlarged, sometimes attaining a size equal to a turkey's egg or an orange, while the others are but little enlarged. The swelling at times is very rapid. Suppuration is not often observed in the fatal cases, and so it happened that suppuration came to be regarded by the inhabitants of the localities where plague prevailed as a favourable sign; while, on the other hand, 'flattening' or subsidence of the swollen glands in the early days of attack was held as indicative of a fatal result. *Boils* and *carbuncles* occur, but not very frequently. *Petechiæ* are often observed, most usually preceding a fatal issue; at times occurring comparatively early in the progress of the disease. Sometimes they are distributed generally over the body, at other times they are chiefly localised in the vicinity of the enlarged glands. They vary in size from the dimensions of a grain of millet to those of a lentil. They are at times so numerous that the skin assumes a livid hue, and the corpse has a blackened appearance after death. This appearance is so characteristic of the disease, says Cabiadis, that the malady might properly have been called, even in this day, *black-death*.

The plague has a special *physiognomy*, having nothing in common with either typhus or pernicious fever in any of its forms, or with relapsing fever. 'The eyes are retracted within the orbits, but not surrounded with the blue circle which is seen in cholera; the aspect is haggard, but without the fixity seen in typhous cases; the facial muscles are relaxed as other muscles of the patient are, and do not present the wrinkles and contractions observed in a patient attacked with typhus or cerebral maladies; the countenance of the plague-stricken expresses apathy' (Castaldi). 'On coming up to a patient suffering from an attack of pernicious fever, you are struck with the gravity of his case and the danger

threatening his life. The very reverse of this meets your eye when you see for the first time a case of plague. Even the worst instances of this malady are apt to deceive an inexperienced physician, and make him fancy that the case is free from danger, when in reality the patient has only a few hours to live. The first instance of plague seen by Dr. Cabiadis did not seem to him to be one of an alarming nature. The patient looked stupefied, as if intoxicated, and did not answer readily the questions put to him. He vomited blood, and had a small bubo in the right axilla, but the pulse and temperature were normal. The patient died a few hours after Dr. Cabiadis' visit' (E. D. Dickson).

3. **Fulminant Plague.**—Cases to which this term is applied have been observed more particularly at the commencement of plague epidemics, but also during their course and towards their termination. These were cases which were struck down suddenly with illness and died in a few hours, without any of the characteristic indications of the disease—buboes and carbuncles, for example—having shown themselves. The conclusion that they were part of the prevailing epidemic—the infection having overwhelmed at once, as it were, the sufferers—appears justified by the prevalence, at the same time, of an intermediate class of cases, also very quickly ending in death, in which some traces of glandular swellings were observed, with profound disturbance of the nervous centres, convulsions or coma, and rapid formation of vibices and purpuric spots. The cases of the fulminant class which occurred at the beginning of the outbreak on the Lower Euphrates, 1873–74, were chiefly marked by vomiting of blood and setting in of a high febrile state concurrently. The natives had named these cases 'black-vomit' before the actual nature of the disease became apparent (Castaldi).

Máhámari (Pali or Indian plague); *Yunnan Plague.*—The recent descriptions of these forms of plague by Planck, Francis, Rocher, and Baber, do not present any such differences in the character of the disease above described as to call for a separate account.

The Plague on the Volga, 1878–79.—Only one account of this outbreak has come into the hands of the writers from the pen of an actual observer, and it merits a particular notice. It is contained in a report of Dr. Döppner, principal medical officer of the Cossack troops in the province of Astrakhan at the time, and is founded on personal observation of twenty-three cases seen by him when the outbreak was approaching its greatest intensity. His description of the symptoms presents them as forming two groups: (1) Violent headache (forehead and temples), pains in the limbs, slight shivering, followed by high fever, pulse from 100 to 120, sense of burning in the body and eyes, distension of the abdomen, and enlargement of the liver. These symptoms lasted two or three days, and were in favourable cases followed by perspiration and recovery with general debility; but in the greater number, after an interval of two or three days, the fever returned, accompanied by delirium, sleeplessness, restlessness, a temperature of 107·6° F., dryness of tongue, frequent involuntary dejections, urine scanty and reddish. Death usually occurred in the second paroxysm (sometimes, but rarely, after a third), preceded by convulsions and a general prostration of the vital powers. (2) In other cases the patient was attacked suddenly with palpitation of the heart, irregularity of pulse, vomiting, vertigo, oppression of the chest, spitting of clear blood, pallor, an apathetic expression, with dulled eyes and dilated pupils. The patient then remained for two or three hours in a state of extreme feebleness, followed by violent feverishness and delirium, suppression of the urine, and constipation. Maculæ appeared upon the body; it exhaled a peculiar odour, something like that of honey; and death supervened in a state of lethargy, with complete prostration of the vital powers.

In neither form of the disease, at this stage of the outbreak, were buboes a conspicuous symptom, and in the latter form they were rarely observed; but buboes (inguinal and other) had characterised a series of non-fatal cases of abortive plague which had preceded the cases described, and during the decline of the outbreak buboes were again observed. Death occurred in from twelve hours to three days. Decomposition of the body always set in rapidly.

Dr. Z. Petresco, of Bucharest, who, under instructions from the Roumanian Government, visited the seat of the plague on the Volga, and reached the infected locality early in February 1879, received accounts of the disease from physicians who had witnessed it at Vetlianka subsequent to the period of time to which Dr. Döppner refers (Nov. 17 (29) to Dec. 4 (16), 1878. He states that the predominant symptoms were intense headache, an acute febrile state (very rarely accompanied by delirium), and excessive prostration of vital force—these symptoms forming a 'triade séméiotique pathognomonique de la peste.' He also states that, at the beginning of the outbreak at Vetlianka, cerebral and lymphatico-glandular disturbances were chiefly noted, the latter manifested by submaxillary, axillary, and inguinal buboes; afterwards, at the height of the epidemic, graver indications of disorder of the nervous centres were observed, manifested especially by headache, vertigo, feverishness, and collapse, the cases at times ending fatally in twelve hours; lastly, during the decline of the epidemic, pulmonary disturbance predominated (hæmoptysis with symp-

toms of catarrhal pneumonia), inducing the medical men to diagnose the malady at this time as a croupous pneumonia, pneumotyphus, or malignant typhus.

Cabiadis and Colvill made an analysis of numerous cases of plague which came under their observation, from which the following particulars are taken in illustration of the foregoing symptoms, and as elucidating other questions.

Seats.—Of these 1,826 cases of Cabiadis' and of 402 cases of Colvill's, the following manifested themselves in the form of buboes and carbuncles:—

	Cabiadis' Cases	Colvill's Cases
Buboes—in the Groin	710	128
„ „ Axilla	466	109
„ „ Neck	98	19
„ „ Crural region	—	2
„ in several places	122	8
„ not revealed	—	9
Carbuncles	36	9

Other Manifestations. — Cabiadis, with respect to the 1,826 cases mentioned above, gives the following numerical statement of the numbers in which noteworthy special symptoms were observed:—

Dependent on the nervous centres	Coma in	28
	Convulsive shake	9
Dependent on the circulatory system.	Petechiæ	120
	Epistaxis	2
	Hæmoptysis	6
	Hæmatemesis	27
	Sanguineous diarrhœa	14
	Menorrhagia	2
Dependent on the assimilative organs.	Bilious vomiting	32
	Bilious diarrhœa	16
	Jaundice	2

Duration.—Colvill shows the duration of 534 fatal cases of plague as follows:—

Days after attack	Number of deaths
One day	126
Two days	80
Three „	105
Four „	76
Five „	60
Six „	26
Seven „	12
Eight „	14
Ten „	14
Twelve days	9
Sixteen „	1
Twenty „	11

Relapses and Second Attacks. — Arnaud notes both relapses and second attacks in his account of the Bengazi outbreak, 1873-74.

Mortality.—The mortality of plague appears to have differed much in different places and at different periods of an epidemic. Colvill states, of the outbreak of 1874-75 in Mesopotamia, that the mortality in the first half of the epidemic in a village was from 93 to 95 per cent. of those attacked, but that during the latter half of the epidemic the greater number of the attacked recovered. The mortality in Bagdad throughout the outbreak in 1876 was, he states, 55·7 per cent. of the attacks (cases 4,585, deaths 2,556). Arnaud gives the mortality during the outbreak in Bengazi, 1874, at 39 per cent. of the attacks (cases 533, deaths 208). According to Cabiadis, the mortality at Hillah in 1876 was 52·6 per cent. of the attacks (cases 1,826, deaths 961). Hirsch estimates the mortality at Vetlianka, on the Volga (Astrakhan), at 82 per cent. of the attacks (cases 439, deaths 358); and Döppner states that at one period of the outbreak there was a mortality of 100 per cent. (in other words, all who were then attacked died), and at another, and later period, of 43 per cent.

Diagnosis.—'No other idiopathic fever, attacking a multitude of persons at the same time, is characterised by glandular swellings, by carbuncles, and by those severe manifestations of the nervous, sanguineous, and biliary systems which declare themselves in an attack of plague' (Cabiadis, according to E. D. Dickson). As regards *pernicious fever*, with which the disease was confounded by some medical men in Mesopotamia, Cabiadis says no intermission has ever been observed in plague; no attack of plague has ever been cut short by the administration of sulphate of quinine; and the expression of countenance and general aspect of a plague-patient are strikingly different from those of a patient affected with pernicious fever. At Vetlianka, intermissions, according to Döppner, were observed.

Prognosis.—'Rapid suppuration of the buboes, even when accompanied with high fever, indicates a favourable termination; all cases complicated with nervous, hæmorrhagic, or bilious manifestations end fatally' (Cabiadis). Colvill is of opinion that the occurrence of diarrhœa in the course of plague, as seen in Mesopotamia, was a favourable sign.

Treatment. — (*a*) *Curative.* — The recent outbreaks of plague have thrown no positive light upon its curative treatment. In Bagdad and Hillah the plan of treatment mainly followed was the internal administration of carbolic acid or of quinine, and the use of leeches and mercurial frictions to the buboes before suppuration. In some instances this plan was thought to have done good, in others it was useless, if not detrimental. In regard to plague, as to other grave general maladies, except those arising from paludal poisoning, curative treatment is at present only possible on general principles, both as regards the systemic and the local symptoms. The practice would appear to be the same in respect to the general symptoms as would guide the physician in the treatment of typhus; in

respect to the local symptoms, such as would apply to ordinary phlegmon.—(β) *Hygienic.* In the present state of our knowledge, more importance is perhaps to be attached to the hygienic treatment of the disease than to the curative. Most important of all, perhaps, is the exposure of the patient to abundant, freely changing air; next is the use of cold or tepid sponging, as the temperature of the body and the state of the skin (as well as the sensations of the patient, if he be sensible) may seem to call for; together with the large administration of drinks (acid—? mineral, or other) to combat the thirst, the judicious use of liquid food, and especially of stimulants when the dropping of the pulse, the coolness of the skin, and the ataxic condition of the patient call for them.

Prevention.—The prevention of plague involves two sorts of considerations, the one relating to the removal of the conditions which favour the development of the disease; the other to the limitation of the spread of the disease, the malady existing. (*a*) The conditions favourable to the development of plague have been already enumerated, and include all those insanitary states of houses, their sites and surroundings, which form the subject of public-health administration; also those states of poverty which have to be dealt with, not only as an economic, but as a public-health question. Of these several conditions, the three which would seem most to call for special attention in this country, in view of impending plague, whether as regards private individuals or as regards local authorities representing communities, are *overcrowding*, *defective ventilation of houses*, and *impoverishment.* (*b*) In respect to the limitation of the disease, the malady being present, the first and most important consideration is the *isolation* of the patient under such circumstances of aëration as are stated above, as well in the interest of the patient himself as of the community; and the *disinfection* of articles of clothing, or bedding, used by him, and of the room he may have occupied. Local authorities have large powers enabling them to provide beforehand, in a mode available for the use of the whole community, hospitals for the isolation of cases of infectious diseases, such as plague, and apparatus and materials for disinfection; and many authorities have already exercised these powers. *See* Public Health.

But *plague* is the subject of special measures in this country, as in every country on the Continent and Mediterranean littoral, to wit, measures of *quarantine.* Quarantine aims at preventing both the introduction of the disease into a country, and its spread, if by accident it should happen to have been introduced, by the isolation for a longer or shorter period, not only of persons *sick* of plague, but, in addition, of *all healthy persons* who may have been exposed, directly or indirectly, to the infection of plague; also by the isolation and disinfection of articles, described under the quarantine law, as susceptible of conveying plague-infection, coming from an infected district. Experience has shown that measures of quarantine against infectious disease are futile, if not impracticable for this country, from the impossibility of closing all channels of introduction, in consequence of the activity and magnitude of our commerce. But quarantine is retained in regard to plague and yellow fever, and has occasionally to be made use of to meet the requirements of other nations, who, failing the adoption of this system here, would be likely to impose disabilities on our shipping with reference to the diseases named. Thus quarantine was revived in respect to plague, at the time of the recent alarm of the disease on the Continent. The doctrine of plague upon which the English Quarantine Act of 1825 is based, as well as the laws of foreign countries relating to the subject, is a traditional one, inconsistent in many respects with the later and more accurate observations which have been made on the mode of spread of the disease. *See* Quarantine.

Great importance has been attached in recent epidemics to the formation of sanitary 'cordons' by which the infected district was supposed to be strictly isolated. But the observations of Tholozan show that the results attributed to these, often very defective, lines of defence must have been due, in many cases, to other causes. In the epidemic of Vetlianka, the limitation of the plague could hardly have been due to the 'triple cordon,' since these arrangements were not completed till the epidemic was declining; but much more to the radical measures of disinfection and destruction which were adopted, and which very possibly prevented the recurrence or permanent acclimatisation of the disease.

J. Netten Radcliffe. J. F. Payne.

PLESSER
PLESSOR (πλήσσω, I strike).—A hammer-like instrument used in percussion, for striking the surface of the body, either directly or indirectly. *See* Physical Examination.

PLESSIMETER
PLEXIMETER (πλήσσω, I strike; and μέτρον, a measure).—A flat instrument used in mediate percussion, by being applied to the surface of the body to receive the stroke of the plessor. *See* Physical Examination.

PLETHORA (πλήθω, I fill).—Fulness of blood. A condition in which the vessels of the body generally, or of any part, are over-distended with blood. *See* Blood, Morbid Conditions of; and Circulation, Disorders of.

PLEURA, Diseases of.—The serous membrane which lines each cavity of the chest, and is so reflected as to cover the lung, is not infrequently the seat of disease. As in its anatomical and physiological relations, so also in its diseases, it presents analogies to the lining membrane of a joint. Its diseases may be of external or of internal causation. They may be considered under the following headings.

1. **Pleura, Injuries of.**—These may be caused in several ways: (1) by violent blows upon the chest—and in this case there is usually at the same time an injury to the lung-tissue, the effects of which to some extent overshadow the pleural lesion and its results; (2) by direct wounds with a knife or blunter instrument, or a bullet; and (3) by fractured ribs. In each case inflammation of the pleura may occur. With the surgical aspect of these cases we here have no concern, and the pleural consequences may be sufficiently gathered from the following paragraphs.

2. **Pleura, Inflammation of.**—Synon.: Pleurisy; Fr. *Pleurésie*; Ger. *Pleuritis.*

Definition.—Pleurisy is defined as an inflammation of the pleura, of whatever nature and extent. Clinically and pathologically, pleurisy differs only in its accidents from inflammation of serous membranes elsewhere, and is the most common of the serous inflammations.

Ætiology.—The causes of pleurisy, if local, may be obvious enough; if general, not so obvious. Of local causes the chief are wounds or bruises of the chest-wall; fracture of the ribs; caries of the spine; escape of irritating matter into the pleural cavity, whether from the costal side, as in periostitis or osteitis, from the pulmonary side, as in phthisical excavation, from disease of the bronchial glands, or from the side of the abdomen, as in gall-stone, hydatid, renal stone, ulcers, subphrenic abscess, and the like. Foreign bodies, again, such as bones or coins from the œsophagus or larynx, have been known to find their way into the pleural cavity, and thus set up mischief. Acute pleurisy, the result of local causes, is usually more or less proportioned to these in its severity and duration; pleurisy of general or systemic causation, on the other hand, though less regular in its career than pneumonia, has yet a certain character of uniformity. The general or systemic causes of this form of pleurisy are very obscure, and none of them are accurately known. There are some grounds for suspecting that a chill alone may be a cause of acute pleurisy; but more probably we have to learn that chill must be associated with other factors. A rheumatic or gouty habit is suspected to be a disposing condition by many, and probably with good reason; in some cases again the influence of syphilis has been recognised. The depression of over-work or harass, the debility of previous illness, and the poison of malaria, are among the more common predisposing causes. Acute pleurisy again often occurs as a part, or as a complication, of other diseases. Thus it is rarely absent in acute pneumonia, and may run on, especially in children, to empyema, and in this the pneumococcus may be found; it occurs also, as cardiac valvulitis and pericarditis occur, in acute rheumatism, but less frequently. Acute pleurisy following scarlatina is probably dependent upon a rheumatic or nephritic sequel; if it arise otherwise in that malady the pleurisy is more often of the profuser kind, and tends to empyema from the outset. Pleurisy arises sometimes after influenza and after measles, when it is probably due to pneumonic irritation; and, with or without obvious pneumonia, after enteric fever; of several cases of the latter kind Eberth's bacillus has been found in the effusion. It is also a common consequence of disease of the kidneys in which hydrothorax may be simply dropsical or the product of pleuritis. In septicæmia and in pyæmia, again, a low pyogenic pleurisy often arises as like effusions arise in the joints, and may be equally or more latent; or it may be caused by the rupture of a pyæmic abscess of the lung into the pleural cavity. The origin of the pleurisy which may accompany puerperal and other septic peritonitis is explained by Recklinghausen's demonstration of lymph-canals between the diaphragm and the pleura; and its supervention in some cases of abscess of the liver may receive a like explanation, though in others the passage is direct by ulceration. Reversely, septic pleurisies spread themselves sometimes from the pleural to the peritoneal cavity. Acute pleurisy, when 'idiopathic,' is more often on the left side (three to two) and is rarely bilateral. When due to more specific causes, such as acute rheumatism or nephritis, it is often bilateral, though rarely of equal severity on the two sides. Acute pleurisy is common at all ages; it is recorded often within the first six months of life; in babies it is readily overlooked unless there be abundant effusion, and not rarely even then. In children the symptoms are often very latent, neither cough nor pain is manifest, or pain may be referred to the abdomen, and, on account of the great mobility of the parts, there is little definite displacement of viscera; yet pleurisy is really more common under one year than between the ages of two and five years. At the age of five it is frequent, but it reaches its maximum frequency in middle life (æt. 35–45). The younger the child the more readily the effusion becomes purulent, and in such cases the mischief may extend to the pericardium, but this is more common perhaps in older persons. Cases of simple inflammatory

pleurisy have been recorded in persons beyond threescore years of age; but in aged persons it is rare, and presents little reaction or pain. The male sex is more often affected than the female, in the ratio of about seven to five; the difference may be due to the class of cases which owe their origin to weather; it does not appear, however, that pleurisy varies in prevalence with the change of the seasons. Pleurisy, under one form or other, is credited with about 2 per cent. of the deaths in England, and with about 1 per cent. of the deaths of patients in public hospitals.

Anatomical Characters.—The morbid anatomy of pleurisies differs but little from that of serous inflammations elsewhere. The costal membrane generally suffers the sooner and the more severely. The vessels become injected and even yield in places, giving rise to small irregular ecchymoses. Effusion of a sero-fibrinous and proliferative kind quickly infiltrates the tissue, and the natural gloss of the membrane gives place to opacity. The superficial epithelium also strips off, and papillæ appear, at first isolated, but soon communicating together by networks of vascular formation. At this point all may clear up, or effusion may escape from the surface. In dry pleurisy the products are chiefly new-tissue elements, without much interstitial effusion. In active cases the effusion is not very voluminous, but is usually highly albuminous and very rich in fibrin; and false-membrane, often of great thickness, forms upon the pleura, and sits tightly. Some of the loose or adherent gluey effusion degenerates, and is absorbed on resolution; some of it organises, and forms more permanent false-membrane or bands of connexion and adhesion. These contain blood-vessels, elastic fibre, lymph-channels, and even nerves (Virchow). Clots of fibrin float freely and abundantly in the effused serum, and contain a great abundance of imprisoned cells. In the fluid itself the cells are fewer, clear, granular or multinuclear. The more of these cells, the greater the fear of a purulent transformation, especially if streptococci be present. In pleuritic effusions, as in other inflammations of serous membranes, staphylococci are but rarely found. The coccus of pneumonia is found only, if at all, during the actual duration of the disease. There are also found abundant free nuclei and a quantity of red blood-corpuscles, varying with the vascularity of the new-growths. If the exudation be less actively inflammatory and more serous, it is usually more abundant, and may amount to 100–150 ounces: it is less disposed to form firm membranes or adhesions. This fluid is of a greenish straw-colour, like synovia, and is thin, with fibrinous coagula in it. It partially coagulates when exposed to the air, and is found to contain more degenerated cell-elements, and perhaps streptococci, and tends towards a sero-purulent character. Dr. Churton of Leeds has found cholesterine more than once as a product of these degenerations; calcareous matter has also been found, even in large masses. In scurvy, tuberculosis, carcinoma, and other cachexias, and even in rare cases of simple pleurisy, the effusion may be highly sanguineous, and blood may be found alike in the coagula, in the free and in the attached false-membranes. In cases of chronic arterial degeneration hæmorrhage may occur in the pleura from ruptured vessels.

When the contents of the pleura are purulent, much of the new membrane has broken up, though even here false-membranes are by no means absent, and fibrinous clots are at times discovered. In cases of large effusion the lung is found compressed, and often bound down by false-membranes extending from the walls of the cavity. In adults the lung is usually found in the vertebra-scapular space; it collapses primarily by its own elasticity and withdraws itself upwards, inwards, and backwards. It may be compressed one-quarter or even one-eighth of its normal volume; it is then flattened, leathery, bloodless and airless, and will sink in water. As the pressure subsides, the lung may, and generally does, recover more or less of its former volume. It is surprising how fully the lung may re-expand in spite of false-membranes, bands, and prolonged compression. Dr. S. West[1] has shown how closely the opposite pleural surfaces tend to cohere even in spite of intrusive matters. Nevertheless, either complete or partial adhesions or bands of connective tissue generally remain indefinitely after acute pleurisy; and, happily, for the most part do no harm. If the lung fail to re-expand to any extent, the deficiency is made up by the inward pressure, partly of neighbouring soft parts, and partly of the chest-wall. Pleuritic adhesions are very commonly found after death from other diseases, their origin being unknown or forgotten. On the other hand, false-membranes and bands may become the seat of degenerative processes; and pus, cretified pus, and the like may be found in them, with or without secondary abscesses elsewhere. A pleural cavity which has thus suffered is more liable to subsequent inflammations. The compressed lung in like manner may become the seat of sclerosis, of degenerative changes, and even of necrosis; in empyema the contact of pus promotes ulcerative and septic changes in the lung, as it does likewise in the vertebræ, ribs, and other neighbouring parts. Thus the pus, finding for itself a passage in the direction of least resistance, pierces through lung or thorax, and establishes a pulmonary or costal fis-

1 'Bradshaw Lecture': *Lancet*, August 20, 1887.

tula. Sometimes the pulmonary fistula is a simple one, and communicates at once by a free or a valvular opening with a bronchial tube, or may have so communicated by an opening afterwards closed; at other times the pus finds a less direct route, and either by a coarse filtration, or by way of many small ulcerating channels, it reaches the more open passages of the lung.

Subpleural ecchymoses, though often accompanying evidences of inflammation, are not always caused by pleurisy. They occur in deaths of children after broncho-pneumonia and diphtheria, but there is usually a patch of pleuritic inflammation upon and co-extensive with them. As the punctiform ecchymosis of Tardieu, they may also be found on the heart, pericardium, and thymus gland, and are not by any means peculiar to deaths by pleurisy: they are not uncommonly found in other deaths also, but are probably always associated with obstruction to the entrance of air into the lung.

In all cases the position of the heart and other viscera must be observed, and the chambers of the heart, the pulmonary veins, the inferior vena cava, and other vessels examined for clots. In empyema a careful examination of the body for secondary abscesses must be made, not forgetting the brain.

Chyle may be found as a pleural effusion, not a few such cases being on record. The nature of these cannot well be ascertained otherwise than by aspiration. Chylothorax may be associated with, and caused by, intrathoracic morbid growths.

Clinical Characters and Varieties.—For convenience of discussion, pleurisy may be divided into six kinds, as follows: (α) *Dry*; (β) *Acute*; (γ) *Diaphragmatic*; (δ) *Quiet, with large effusion*; (ε) *Tubercular*; (ζ) *Fibroid*. Each of these requires separate consideration. Effusion, when present, may be serous or may be purulent, or a serous effusion may change into a purulent; but since antiseptic precautions in operative procedure have been perfected, this change is rarely witnessed.

(α) **Dry Pleurisy.**—This is so called because it is attended with no effusion, or with effusion so slight as to escape notice. Usually, if not always, it results in an adhesion of the opposite surfaces of the membrane. It may not be revealed by any sign or symptom during life. Adhesions, more or less extensive, due to this process, are very often found after death. Dry pleurisy may occur alone, or as a complication of irritative changes in neighbouring tissues, as in the lung or chest-wall. Pain or pyrexia, more or less fugitive, may accompany dry pleurisy; but in many cases, if present, they pass unnoticed. Should attention be drawn to the chest, friction may generally be detected—in the early stages. An obscure pain in the chest or loin, or a frequent teasing dry cough, may at times be traced by the close observer to a patch of dry pleurisy in some part of the chest. A friction-sound due to such a patch may be transient, or may be audible for many weeks. It is supposed that some of the pains in the chest which accompany phthisis are due to the intercurrence of dry pleurisy; probably, however, they are as frequently myalgic (cough) or neuralgic. Dry pleurisy, with its resulting adhesions, is rarely injurious. Indeed, it is rather a safeguard when any destructive process, such as phthisical ulceration, threatens to bore into the pleural cavity. If it fail, and morbid matters escape into the cavity, acute pleurisy and pneumothorax are the probable consequences. Dry pleurisy often ends in but slight thickening, the two pleural surfaces adhering without much increase of substance. In other cases the thickening may be considerable, but this probably would indicate some more persistent irritation, such as we find, for example, in those dense coverings which often surround the apex of a lung in chronic phthisis. The remoter consequences of dry pleurisy are for the most part without importance. In some instances it may limit the chest-movements, or, more rarely still, may so tie the parts as to cause abiding pains, described as dragging or tightening. Such pains are usually referred to the sub-axillary or sub-mammary regions, and may be really annoying. More often they do harm by ministering to needless fears. A generally adherent lung is usually small, and it may be more liable to undergo degeneration or tubercular infection. It is said that in rare cases hypertrophy of the heart has resulted from the embarrassment of its action by pleural bands. Dr. Bowditch tells the writer that he has seen this twice at least.

It is useless to prescribe treatment for a disease which escapes observation, or is but a secondary event in the course of more serious processes. Where dry pleurisy is found, and is doing harm by exciting cough or otherwise, the best practice is to place several light blisters in succession over the affected part, and to watch the patient closely in all respects.

(β) **Acute Pleurisy.**—Acute pleurisy, though less serious than chronic effusive pleurisy, is far more serious than dry pleurisy, and generally appears as an important illness. It sets in with fever, pain, embarrassment of the breathing and cough, sometimes catarrhal, usually reflex. These symptoms bear no certain proportion to each other. The fever has no very characteristic type, but is rather what is known as a symptomatic pyrexia. Speaking generally, there is not a sharp rigor of onset, as in pleuro-pneumonia, but there is often a succession of lesser chills. Nor are there any very definite stages of increment, but rather a daily fluctuation of

remittent, more rarely of intermittent type, with evening rise, the elevations not often reaching and rarely exceeding 40° C. (104° F.) At first the blood-pressure is high, the pulse being small and hard; after the first onset the pressure falls, and the pulse becomes dicrotic. As the effusion reaches its height, the fever in acute pleurisy gradually recedes, unless the case approaches to the form (δ), when the effusion is indeterminate, and the fever may subside, may fluctuate, or may drift into hectic. The pain is often very characteristic, but at other times is variable, and even delusive. Most commonly it appears as a stitch in the side, about the level of the false ribs, which is intensified by inspiration and cough. The deep breath when partly drawn is cut short, as if with a stab, while the face of the patient is wrung with an expression of sudden distress. Such inspirations are, however, instinctively avoided, and may have to be called for by the physician, so that the face may speak rather of apprehended than of actual suffering; in either case the expression is a telling one to the practised observer. The fixed alæ nasi, which are dilated, but do not oscillate as in some other kinds of dyspnœa, the parted lips, the bright eye of fresh fever, the cheeks flushed but not congested as in pleuro-pneumonia, the preoccupied and apprehensive expression, the posture semi-erect, slightly bent forward and toward the affected side, the shallow breathing, the fixed chest, the hand on the side, the curt speech, the stifled cough, make up a clinical picture often seen, and easy of recognition. It is a curious fact that these symptoms of distress are generally more marked in a robust patient, or one previously healthy, than in the ailing, weakly, or cachectic. The pain, however, may wander from the lateral or ante-lateral aspect of the lower ribs, and appear in the hypochondrium, or even on the opposite side. At other times it may become more diffused, and play upon the brachial plexus, darting from the clavicular and scapular districts to the upper chest, shoulder, or arm. This is, perhaps, more common in the diaphragmatic variety (γ). In some bad cases, in which pus forms from the beginning or almost from the beginning, the pain is very distressing and prolonged, and the rigor very strong. Whatever be the treatment, we look for some relief of pain, cough, and conscious dyspnœa on the third or fourth day.[1] The respirations, however, may still range above the normal rate, from the mechanical interference of increasing effusion or of this increase combined with œdema of the open parts of the embarrassed lung, and perhaps of its overworked follow. About the end of the week, be it more or less, the pleurisy has run its course, and the effusion has, in favourable cases, attained its maximum; the urinary, gastric, and other glands regain their normal activity; and convalescence, with absorption of the exudations, is to be looked for. Thus far, then, the disease is painful rather than dangerous, death in the first week of ordinary acute pleurisy being practically out of the question. Malignant cases of pleurisy, however, occur, in which the temperature may be 40° or 41° C. (104°, 105·4° F.), the pulse reach 140, the tongue become dry and brown, the prostration excessive, and the exudation run promptly to pus—pus which may be fœtid, although without obvious reason. Such cases are rare, except as complications of septic and other diseases, and they are generally fatal, even after free evacuation of pus by incision. An important instance of recovery from such a case has been reported by Drs. Gairdner and Buchanan.[1] By certain signs in the chest we know the height to which the fluid has flowed in the cavity, and we await its ebb. Usually, in a day or two, some fall is noted, and in favourable cases this ebb runs quickly at first, and afterwards more slowly as the products become denser. Some remnant is usually to be detected after the patient is about; and months, or even years, may elapse before the parts become normally clear. Indeed, the signs of an old pleurisy may be carried to the grave. Probable as is this favourable result in strong persons, yet it is not to be too lightly promised even to these. Too often when we are awaiting the ebb we find a new flood, the level of the fluid rises into the upper chest, and the patient, who hitherto has lain on the sound side to avoid pain, now turns on the affected side to give full play to the open lung. This flow may recur with or without renewed fever, but is generally attended with a proportionate increase of pulse-rate, and diminution of pulse in volume and tension. Coincident with the diminution of blood-pressure, which in its turn is due to the pulmonary obstruction, is a diminution of the urine, which, probably, had become more abundant as the fever ceased. That the changes, both of pulse and urine, depend upon the effusion is shown by the rapid recovery of both when fluid is artificially let out from the pleura; the pulse then falls in rate and increases in tone under the finger, and the urine soon becomes more abundant. A little albumen is sometimes present during the time of pulmonary obstruction (*see* ALBUMOSURIA). Under ordinary circumstances a renewed flow of urine may be indicative of pleural absorption, or the case may pass on into the form (δ), or into an empyema. Neither of the latter events is common, however, except as

[1] Writers are not yet agreed whether there be any local elevation of temperature in the affected side or not. Still less can it be said whether such local temperature runs any definite course of change.

[1] *Glasgow Med. Journ.*, Feb. 1883.

a consequence of neglect, the symptoms preceding these being generally of a quieter character. It is hard to tell when the full chest contains *serum* and when *pus*, and by direct observation alone it is usually impossible. Marked hectic may exist with serum, but if this be associated with increased temperature, tenderness or subcutaneous œdema of the affected side, change of countenance, loss of appetite, wasting of flesh, failure of strength, thrush, diarrhœa, or with any of them, and the more if there be any inherent constitutional frailty, a preceding acute specific fever, or a septic infection, we must fear that tubercle is present, or the fluid turning to pus. The discovery of streptococci in the fluid would indicate the latter event. In the later weeks or months of an acute pleurisy which has not ended in resolution, death may threaten and may not be averted. In some cases, as after scarlatina, or pneumonia, and especially in children, the effusion may be purulent from the beginning, and a fatal result may be feared even in the earlier days of the malady. Under ordinary circumstances, however, in healthy persons who have been carefully treated from the outset, and who have not been exposed to septic or malarious influences, we expect to have to deal with effusions moderate in quantity and stable in quality. The effusion in such cases rarely remains at its height more than two or three days; and in three weeks at farthest absorption should be tolerably complete. We must not therefore be too ready to tap in such cases. In other cases, fortunately rare, acute pleurisy, with remittent fever, continues for many weeks. Effusion in these cases may not be very rapid, but recurs gradually after the removal of moderate quantities; or it may not seem to need removal. The signs are simply those of acute pleurisy, but resolution does not take place, or is indefinitely deferred. Death may result in such cases, or the patient may slowly recover. After death may be found evidences only of active simple inflammation, partial or complete obliteration of the lung, and sero-fibrinous exudation. The other side, and the rest of the body, may be quite healthy. The name *relapsing pleurisy* might be given to these cases. When inflammation falls upon both pleuræ, it generally falls also upon the pericardium, and such cases are terribly dangerous. Even if moderate in degree in each, yet taken together the embarrassments of the patient become very grave, and death may imminently threaten. It is important to give relief by puncture as early as possible. The discovery of pneumococci in an exudation would, of course, indicate pneumonia also.

(γ) **Diaphragmatic Pleurisy.** — Diaphragmatic pleurisy is not essentially different from the preceding, but the symptoms are peculiar.[1] If the inflammation be, as it may be, exclusively diaphragmatic, and not costo-pulmonary, then the ordinary physical signs of pleurisy with effusion are either absent, or so ill-marked as to puzzle the inexperienced practitioner. In diaphragmatic pleurisy the patient may be taken as acutely as in ordinary pleurisy, or the fever may even be higher; but his distress is different, greater and more serious. The practitioner is surprised and perplexed to find a person, in whom he can discover no important organic defect, in an agony as it were mortal. The presence of pain shooting from the lower ribs of one side suggests pleurisy; but the ribs of both sides play with perhaps more than normal freedom, and no physical signs may be audible, unless it be that the practised ear may detect a want of breath-murmur at the base of one lung, and, after the first day or two, it may be, two finger-breadths of dulness there. Still no friction may be heard, and it seems impossible at first sight to credit signs so slight with clinical phenomena so alarming. For the patient is as one having a clot in the heart, or a sudden perforation of the pleura, so terrible and so absorbing is the strife for inspirations which never satisfy, so keen the dread of any handling which may interfere with the one permanent need of sitting erect, and of keeping the upper respiratory muscles in full play. These inspirations may range from forty to fifty in the minute, or may even run with the seconds, except only when cut by a hiccup or a heaving of the stomach. To this are added the suffering of pain which shoots through the waist to the back, or darts round the shoulder-blade and collar into the shoulder, and a sense of a fatal grip. The fever may not be actually higher than in ordinary acute pleurisy, and the normal character of the heart-sounds gives great confidence to the physician; abdominal breathing, however, is lessened, and any pressure upwards upon the diaphragm is resented. All these things finally lead to the conclusion that acute inflammation has partially attacked and so far paralysed or inhibited the diaphragm, without extending far upon the pleura above; and the diagnosis is of course the easier if pleurisy be discovered elsewhere in the chest. A patient thus attacked seems to be in no little danger, but recovery may be anticipated if the mischief come not from below. Fortunately the malady is far less common than ordinary pleurisy, and indeed may be called rare. As stated above, however, inflammation of the diaphragm may complicate ordinary pleurisy,

[1] Wintrich is indisposed to admit that the symptoms of diaphragmatic pleurisy are so characteristic as herein described. Diaphragmatic pleurisy may exist without setting up such marked and special symptoms, but the present writer speaks of his own experience.

and introduce both the pains in the brachial plexus and the excessive and paroxysmal dyspnœa. An empyema or other effusion lying between the diaphragm and the pleura may be out of the reach of direct diagnosis, unless the needle be used, and may have a latent commencement.

(δ) **Quiet Pleurisy with Effusion.**—This form of pleurisy is commonly said to be the soquel of acute pleurisy; but if we except a few cases in which pleurisy, at first sthenic, afterwards follows the asthenic tendencies of the patient, and those in which acute pleurisy has been treated with neglect, we shall find that in the large majority of the remainder this form begins not sharply but quietly, and indeed is often unnoticed until the chest is laden with fluid. If the patient suffered pain it was too slight or too indefinite to ensure attention; the low fever, unmeasured by the thermometer, escaped observation; the chest, slowly invaded, accommodated itself to circumstances until the fluid had nearly filled the cavity; and even then the patient may be brought to the doctor only by a sense of dyspnœa on ascending hills or stairs. A quick eye may detect in him an expansion of the alæ nasi; or, indeed, may see that the patient—almost unknown to himself—is breathing at double, or nearly double, the normal rate; or, again, a sensitive patient and a vigilant physician may fully perceive the remittent—almost intermittent—fever, the indefinite pain and the encroaching effusion, and may lessen the evil by timely interference. As a rule, where effusion is large the patient lies on the affected side, thereby escaping the pressure of the fluid upon the mediastinum, and enabling the sound lung to have free play. This decubitus is not, however, invariable, and is avoided if the affected side be painful. With pyogenic change in the effusion the patient may turn off the affected side, as this change is sometimes accompanied by a renewal of tenderness to pressure. When the effusion has come on very gradually, the patient may be able even to lie on either side indifferently. Occasionally a large pleural effusion may cause some difficulty of swallowing. Let the reader then remember that pleurisy running to large serous effusion not only may be, but very often is quiet; and not only may be, but not uncommonly is overlooked until matters come to an extremity. Even if the effusion be purulent, its accumulation may be equally rapid or equally silent; being silent when it is the further change of a serous effusion, being silent and rapid when it comes as pus almost, or quite, from the outset, as in septic and infectious diseases, and in children. If acute pleurisy drift into chronic pleurisy, tho fever, which may have vanished for a time, lights up again fitfully at times, and fresh brushes of inflammation take place in the pleura and in the new membrancs. With this there are also renewed outpourings of serum, and these sometimes increase so rapidly as to put the patient in imminent danger of death by syncope. The fever in these stages is often hectic in character, so that the presence of hectic alone does not prove the effusion to be purulent. Quiet effusive pleurisy is very uncertain in duration. Should the effusion be not excessive, and remain serous, months may elapse—nay, even years—before it is absorbed; and the absorption may be gradual, or may be deferred for awhile, and then completed more quickly. It is needless to say that even so favourable a result as this cannot do away with the injury which the chest must suffer from being waterlogged for so long a time. Very frequently, however, the effusion is sero-purulent or purulent; and if left to itself finds an exit gradually by many little ulcerated spots through the filtering lung, and so is gradually expectorated; or, by an opening into a bronchial tube, rushes with a sudden and copious discharge into the mouth. The expectoration in the former case is usually profuse, inoffensive, and muco-purulent; in the latter, the gush of pus, often stinking, is sometimes so great and so sudden as to swamp the lungs and threaten or even produce suffocation, especially if it occur during sleep. In either case we have usually to deal with a subsequent pyopneumothorax, which, if left to itself, may ultimately heal, but will probably end in death by slow hectic and marasmus. The issue is more promising if the pus find its way outwards between the ribs, and this it may do by a direct opening, usually in the fifth space towards the front, or a sinuous opening; or it may gather between the ribs and skin, forming there a large superficial abscess—'*empyema necessitatis*,' the tension of which varies with respiration and increases with cough, and this of course more or less readily as the communication is more or less direct. These changes in tension aid us in distinguishing such issues of the pleural cavity from local abscesses of the chest-walls. The chest, however, is imperfectly emptied; septic poisoning is but partially prevented; and a lingering illness must be cut short by operation. Again, the pus may find its way into the opposite pleura, thus doubling the empyema, and even such cases have recovered; or into the pericardial or peritoneal cavities, though such terrible events are fortunately rare; or it may burrow between the tissues and appear at distant places, and thus may mimic psoas or other sinuous abscess. A cure of empyema by reabsorption is said to be possible, but tho possibility must be a bare one, except in the case of small encysted collections.

In some cases the fluid may rise in twenty-four hours from the angle of the scapula to the clavicle—an obliteration of breathing

space far more terrible in its rapidity than a more gradual one to which the system slowly adapts itself. Largely effusive pleurisies have no definite course, for absorption is difficult, and so far as it occurs is too often compensated by renewed febrile movements, with renewed effusions. The lower character of the exudations, their lack of vessels, and the compression of those which exist, hinder such absorption as may be possible in weakly persons. Thus the fluid either is or becomes purulent, and makes for itself an outlet.

(ε) **Tubercular Pleurisy.** — In considering the relations of pleurisy to tubercle we have to deal with four classes of cases: (1) Those in which one or more attacks of pleurisy, not apparently itself tubercular, have preceded phthisis. (2) Those in which tubercle may arise in the exudations of a pleurisy thitherto simply inflammatory. (3) Those in which pleurisies spring up here and there in the course of pulmonary phthisis. (4) Those in which the pleurisy is tubercular in its origin and development.

These states will be best considered reversely, beginning with the last. True tubercular pleurisy is not uncommon, but, apart from tubercle in other parts, rarely destroys life directly, and, being a part of general tuberculosis, is not therefore found alone upon the *post-mortem* table. Tubercle, however, sometimes betrays its presence in the pleura before it manifests itself elsewhere, so that the occurrence of pleurisy without definite cause in a delicate person should always excite suspicion, and this the more if patches of inflammation spring up here and there in the membranes of the two sides without much resulting effusion. The fluxion of tubercles is generally insufficient to produce much effusion, though of course many sero-fibrinous or even sero-purulent pleurisies are of tubercular causation, direct or indirect; the fact of recovery does not necessarily prove the non-tubercular nature of the case. No great difficulty arises in deciding upon the nature of those intercurrent pleurisies which are coincident with, and so often caused by, pulmonary phthisis in the neighbourhood. These very commonly are not tubercular in a strict sense. More difficulty will be found in foreseeing or detecting tubercle in a pleurisy apparently simple. Tuberculous pleurisies of this second class are not uncommonly met with in practice, and followed to the *post-mortem* table. A pleurisy, severe or not, but seemingly of simple nature, appears to progress towards recovery, or perhaps, indeed, to reach recovery. The temperature, however, if it has fallen, fitfully rises again and the pulse quickens, yet without much evidence of empyema or of any returning effusion. After a longer or shorter interval a patch of pleurisy on the other side, or a sign of mischief at the apex of a lung, may betray the character of the relapse. These cases end as more or less generalised tuberculosis, and in the pleura or the old false-membranes are found the caseous or softened residue of the first crop. Most difficult of forecast are the pleurisies of the first class, which, however painful or profuse, end in recovery which seems complete. The patient, who has returned to the labours and delights of life, begins, however, to be hectic and to cough shortly and drily; signs of phthisis are detected in the lung; and the end comes in the too familiar way. The tubercle bacillus is very rarely found in the products of pleural paracentesis; indeed, the absence of any micro-organisms whatever in a purulent exudation may even suggest tubercle. For some reason or other tubercular effusions are often malodorous. The reactions of a patient to tuberculin might in a case of difficulty aid the diagnosis. The physician must regard with positive anxiety all pleurisies, however frank they may seem, or however happy in their resolution, which arise in delicate subjects, or in the members of families tainted with consumption.

(ζ) **Fibroid Pleurisy.**—Sometimes as a primary affection, but more often as an ultimate consequence of ordinary or of latent pleurisy, the membrane slowly thickens, and, allying itself with a like irritation of the connective elements of the lung, increases at the expense of the proper tissue of the lung; then, gradually contracting after its kind, it stifles and destroys a great part of that organ. Fibroid pleurisy generally begins at the base of the lung, and the pulmonary membrane may increase until it may form a dense leathery covering of even one-third of an inch in thickness. The disease is very chronic, and as the irritative overgrowth of the connective elements slowly advances into the lung, and is chiefly important as affecting the lung, little more need be said about it in this place. Fortunately the affection is rare, and it has not therefore received the attention it deserves. It enters into the class known at present as the chronic non-bacillary fibroid phthisis described by the late Sir Andrew Clark. Cough and dyspnœa, abiding dulness on percussion, lack of expansion, symptoms of pulmonary irritation and bronchiectasis, all following a known attack of pleurisy, should excite suspicion of such a fibroid hyperplasia. The causes of this abiding irritation are very obscure; the abuse of alcohol seems to be among them.

Hæmorrhagic Exudation.—Pleurisy may be attended with other peculiar features of not sufficient importance to justify its division into further varieties. For instance, it may be attended with *hæmorrhagic exudation*—that is, with exudation mixed with more or less blood, the loss of which may be exhausting, as is often seen in empyemas. These

cases, though sometimes very acute, are usually chronic; and the hæmorrhage depends, as we have said, on bleeding of the new vascular tissues, which, moreover, may be due to some further abnormal state of the patient, such as scurvy, carcinoma, arterio-sclerosis, or tubercle. It seems probable that hæmorrhages do not suppurate unless micro-organisms gain access to them, and tend to do well if other conditions are favourable. A small quantity of blood may give to a body of serum a very sanguineous hue, but its specific gravity would remain low. A serous may quickly follow a hæmorrhagic effusion after paracentesis.

Pyopneumothorax. — This is a term applied to that condition in which, on perforation into or from some open channel, air finds entrance into a cavity, which is or becomes empyematous. At the same time pus is evacuated. The lung may in a measure expand, or in neglected cases may be irrecoverable; the chest-wall falls in more or less, according to the rigidity of the ribs in the individual. Dulness now gives way to clearer and lower notes, except in such dependent parts as may still be occupied by effusion; and the pitch will vary according to the thickness and density of the false membranes within, and to the degree of pulmonary expansion. If the fistula be moderate in size, little or no blowing sound will be heard; pus may indeed be spit up from an empyematous cavity, without the access of air to the cavity, the opening being in such cases valvular or quasi-valvular. Three additional auscultatory signs may also be obtained, which are alike in nature, but are distinguishable as *succussion*, *metallic tinkling*, and *bell sound*. *See* Lung, Perforation of; and section 3. Pleura, Air in.

Physical Signs.—These are to be detected by the usual methods. Throughout the stages of pleurisy *inspection* will tell us that the movements of the affected side are lessened either by the warning of pain indirectly, or directly by effusion which stops the play of the lung. This diminution of movement is often to be noted also in the abdomen on the same side, especially in diaphragmatic pleurisy. If the effusion greatly increase, the chest may or may not be seen to bulge beyond its true lines; the intercostal spaces are usually, but not always, flattened up to the level of the ribs, and the form of the affected moiety of the chest becomes more cylindrical, as is best shown by the cyrtometer. The diaphragm may be so thrust down and forward as to cause a fulness in the epigastrium; in large effusions there may be bulging even of the supraclavicular space; and the outline of the affected side measured in the transverse submammary line will usually measure more than on the healthy side. Half an inch is an important difference, seeing that in a young adult the other and healthy side in overwork expands about half an inch or more beyond the normal, and will fall again as the compressed lung expands after paracentesis. In recent effusions the skin is often obviously stretched. Œdema of the skin on the affected side is occasionally present, and, though not decisive of pus, is less common in serous effusions. It is confined to the affected side, but sometimes extends far beyond the chest-wall. The state of the veins of the neck must also be noted, and of those upon the chest. Much enlargement of these would suggest intrathoracic tumour rather than fluid, as in like manner would inequality of the pupils, or other evidence of solid pressure within. Clubbing of the fingers may often be seen in old cases of pleuritic effusion not necessarily phthisical, and the feature recedes if the patient advances towards recovery. The presence or absence of a heart-beat, and its position if present, must be noted. If fluid be in the left chest, a diffused pulsation in a tumid epigastrium often replaces the proper apex-beat, or the heart-beat may be felt or heard towards the right breast; if in the right chest, this beat may be detected towards or upon the left axillary line. In some cases of limited but complete dulness in the anterior and inferior region of the left chest, it may be difficult to decide between fluid and pleuro-diaphragmatic adhesions. In the latter case tapping might be attended with some risk of perforating the diaphragm. M. Jaccoud says the distinction may be made in some cases of adhesion by observing traction upon the lower ribs and spaces in forced breathing, so that the spaces are drawn in on inspiration, and the ribs drawn towards the median line. But puncture in so dangerous a situation would rarely be desired. In some rare cases of empyema the whole of the affected side so pulsates as to simulate a large aneurysm, a phenomenon which has not yet received a satisfactory explanation (*see* Diagnosis). Finally, in large effusions there is often some prominence in the hypochondrium of the same side; the nipple drifts farther from the sternum, and the shoulder-blade is thrust somewhat out and away from the spine. All these displacements and changes of shape are of course more readily brought about in young subjects, and in women more readily than in men. In children, also, on account of the elasticity of the parts, we find proportionately less visceral displacement. The female diaphragm is more readily depressed than the male, and the right side of it more readily than the left. In neglected cases absorptive and atrophic changes tend to bring about a retraction of the affected side; the thoracic and intercostal muscles waste; and the ribs fall together with corresponding flexure of the spine, and great elevation of the heart or liver. Such a deformity may, indeed, be

permanent if the lung be obliterated; happily this is not generally the case.

Palpation will help us to find the heart's beat; and to ascertain whether the liver or the spleen be displaced, and so forth. By the hand we may sometimes detect the creaking of friction; and we may verify the imperfect expansion of the side or abdomen, the levelling of the intercostal spaces up to the ribs, and possibly fluctuation in the former. The most distinctive sign to the hand, however, is the loss of the vocal thrill, which is arrested by fluid effusion. This is normally more distinct over the lower two-thirds of the chest. Here effusions usually first accumulate, and loss of this thrill is almost pathognomonic of them; for it occurs besides only with those intrathoracic growths which by their size or position close the bronchial tubes, or in certain rare cases of very severe pneumonia with blocking of the tubes. Unfortunately, sometimes, when most wanted, the voice fails to awaken a thrill in normal parts. Sometimes the limits of the thrill may give a gauge of the height of the effusion. Above the limits of the effusion or near the spine the thrill is often more distinct than it is over the corresponding part of the sound side, and it is said to be present at times, or even increased when, after re-absorption or withdrawal, but a very thin layer of fluid lies between the lung and the chest-wall.[1] In such a case dulness would of course be still present. It must be remembered, if collapsed lung lie between the hand and fluid, that the vocal fremitus is none the less diminished.

Percussion of course reveals to us a higher or duller note over the whole extent of the fluid. But it cannot always tell us the amount of fluid present, as the level of this depends on the state of the lung and of intrathoracic tension and displacement. Moreover, during absorption, dulness depending upon thick false-membranes cannot be easily distinguished from that due to fluid. Such membranes may diminish vocal fremitus also. When fluid is present in quantity the note struck is dull, as if struck upon the thigh, and the stricken finger receives a peculiar sense of dead opposition, owing to the loss of resilience or vibration in the chest-wall. Extreme degrees of consolidation, however, may rival fluid in these characters. On the other hand, in effusion the level of the dulness may perhaps vary with the position of the patient, if its quantity be moderate, and it be unconfined by adhesions. Gravitation, however, helps us less in pleuritic effusions than in pleural and other dropsies, as in the former case the fluid is more liable to be sacculated, and may often be suspended by adhesion above the base line of the cavity. If the fluid be not sacculated it must sway no doubt more or less, but practically we can rarely follow its changes of position. If the pleura seem full of fluid, but the lung be not much compressed, direct percussion by the finger-tips will give a very dull note and a sense of resistance, while stronger mediate percussion will bring out a note of somewhat lower pitch. Usually the level of the fluid is a little lower in front than laterally and behind, as the lung, if free from much adhesion, shrinks, by its own elasticity in the first instance, upwards, inwards, and backwards, so that it may be detected by a clearer percussion-sound on the corresponding side of the four or five upper dorsal vertebræ.[1] In acute pleurisy the fluid rarely rises above the third rib in front; but in quiet effusive pleurisy the whole moiety of the chest may become very dull upwards and across to the opposite parasternal line, and there may be dulness and actual bulging in the supraclavicular space. When the chest contains a good deal of fluid, but is not full, percussion over certain areas may actually give a low or tympanitic percussion-note. These tympanitic areas may be of three kinds—(1) where a thin layer of fluid lies over expanded lung; (2) where distended air-cells compensate cells closed in another part;[2] (3) where, the chest being full of fluid and the lung collapsed, percussion in the neighbourhood of the trachea and large bronchi causes vibration therein. Tympany, when present, is nearly always immediately under the clavicle. If the tympany be due to the third cause, it may have something of the cracked-pot quality. In some cases the tympany is decreased on inspiration and increased on expiration. The detection of tympany under the clavicle may mislead the unwary into a belief that the healthy side is morbidly dull; but on the other hand it is an invaluable help to the physician who takes it as a hint to look for mischief below: in rare cases this may be extensive consolidation without fluid. Dulness due to a displaced liver may be distinguished by the removal of its boundaries on inspiration, and by its anterior rather than posterior disposition. In mere hydrothorax the lung generally rises more readily, and the diaphragm and other parts can usually be made to move in respiration.

Auscultation, before any dulness appears, usually reveals the respiration at the part to be defective in quantity, rhythm, or quality; and there a friction-sound may be audible. Defective inspiration at the outset is due to

[1] This has been noted by Dr. Griffith of Leeds (*Med. Chron.* 1889), who also says, 'The first sign to become normal is, as a rule, the vocal fremitus;' and further 'that this often becomes greater than normal.' Speaking generally, the writer believes that Dr. Griffith is right.

[1] Broadbent, *Lancet*, May 1884.

[2] Dr. Bristowe attributes skodaic resonance to a diminution in the area of the chest-wall which vibrates.

arrest of that act; afterwards it is due to the false-membranes and effusion which favour collapse of the lung, hinder conduction of sound, and ultimately silence it. A friction-sound, if ever generated, may be fugitive and escape the observer, or the embarrassed chest-movements may fail to give it distinctness. When present it appears at the outset, and disappears as effusion separates the surfaces; it may reappear as the fluid is absorbed. The friction of outset may last but a few hours, and except in dry pleurisy is rarely abiding; returning friction, however, may continue for a longer time, even for weeks. In those cases in which the surfaces do not separate, and friction continues for many days without a break, we have to deal most frequently with the drier pleurisies, or those of some cachexias or of septicæmia. It is not uncommon to find a friction-sound abiding so long as the patient can be kept under observation; these quasi-permanent rubs seem often to be without much practical importance. Diminished breathing and friction, if effusion gather, are followed by intermediate phenomena due to thin layers of fluid. These are bronchial breathing, bronchophony, and ægophony. Ægophony is nearly always heard near the root of the lung under the scapula; it has the character of a bleat, and when once heard is not easily forgotten. Its presence is pathognomonic of fluid;[1] but it is so often absent that it is of little practical value. As fluid increases, these phenomena give place to silence; and as fluid gathers first at the bottom we often find silence at the base; bronchial resonance amounting, it may be, to ægophony at mid-lung; and either defective or compensatory breathing at the apex. We may also meet with curious inverse changes in the physical signs, notwithstanding an increase of fluid, if at first this be spread over a partially expanded lung, and afterwards accumulate below it as the lung collapses, or as intrathoracic pressure tells on the other side. Thus dulness may actually recede with an increase of fluid, or on the other hand may rise upwards as with a diminution of fluid the re-inflated lung descends. For these and other reasons it is very difficult to gauge the ebb of intrathoracic effusions, or accurately to ascertain their behaviour after tapping. In children, bronchial breathing and bronchophony often, but not always, persist throughout. Dr. Bowditch used to say that he was occasionally greatly embarrassed in deciding about re-accumulations. 'At times after the effusion has been withdrawn the chest remains as flat as ever, and often it never clears up in the lower part of the affected side; but if it remains in this state without producing untoward symptoms, I have not tapped again, though a tentative aspiration could do no harm.' In cases where the lung is unbound, gauging is of course the more easy. When the chest is quite full of fluid, there may be no response to ear or hand; but even in such cases a faint but distinct respiratory *souffle* is occasionally audible almost down to the base. Moreover, breathing more or less tubular, and some resonance on percussion, are generally to be heard over the root of the lung in the vertebra-scapular space. As air re-enters the lung, respiration is at first defective, and accompanied by *râles* which are probably due to degrees of œdema; sometimes this œdema is severe and persistent, and abundant *râles* with watery expectoration last for many days. This is not uncommon after paracentesis. Respiration then improves gradually, and reinforces itself as the lung expands and clears. The pneumonia of children being often lobular, the discovery in them of bronchial breathing and bronchophony is suggestive of fluid, though lobar consolidation is of course not uncommon in them. In the other lung there is usually a slight general lowering of the percussion-note and compensatory breathing; if the effusion be large enough to compress the opposite lung, the percussion-note may be very markedly lowered. The gradual formation of a pulmonary fistula may in some cases be revealed some days or hours before evacuation, by the presence of liquid *râles* in the upper third of the affected side.

For *bruit d'airain* (bell-sound) and other curiosities, *see* Physical Examination.

Diagnosis.—The difficulties of diagnosis in pleurisy belong chiefly to the earliest and to the latest stages of the malady. In the earliest stage the pleurisy may be latent, and so beyond the possibility of diagnosis; or a pain may be felt, and, setting aside other causes, this pain may be due to pleurisy or to pleurodynia. The pain is often referred to the loin or abdomen, thus leading to suspicion of mischief elsewhere. In the previous history a catching of cold, and the arthritic diathesis, would tell equally in favour of either view; while prolonged anæmia and leucorrhœa would lead us to think of the latter. Unfortunately a comparison of local temperature in the two sides seems untrustworthy, but the presence of fever would make us strongly suspicious of pleurisy. It must not be supposed that diagnosis in this early stage is unimportant. Few errors are more common than the attribution of pleuritic pains to pleurodynia; the pain disappears as an effusion slowly accumulates, and mischief and peril, perhaps hardly remediable, may be the consequences. The careful observer will listen anxiously to the chest day by day, or more than daily, until a friction-sound be audible;

[1] Several modifications of pectoriloquy have been relied upon by Baccelli and other writers as means of distinguishing between pus and serum in the pleura. Dr. Bowditch informed the writer many years ago that the signs in question do not bear out the value which has been claimed for them; the phenomena probably vary, not with the density of the effusion, but with states of the lung.

and this once heard, further mistake is impossible. Fever of course may be present with pleurodynia, and an immediate diagnosis would then be impossible, unless something characteristic in the stitch and start on deep inspiration betray the real state of things. Neuralgic and inflammatory diseases of the walls of the chest are not likely to give rise to any permanent misunderstanding. It is said that a pericardial may be mistaken for a pleuritic friction-sound, but the distinction can rarely be difficult, except where a localised pleurisy affecting a patch overlying the pericardium may gain a cardiac rhythm. A difficulty is more likely to arise in distinguishing between a pericardial and a localised pleuritic effusion. Still this can hardly be insuperable. In rheumatic fever, scarlatina, and some other diseases pericardial may accompany or ensue upon pleuritic effusion, and when the latter is on the left side, and is abundant, the limit between the two may be beyond definition. The practical lesson is to remember the likelihood of pericardial effusion, and not to overlook it if it come.

In the later stages of pleurisy, when effusion is abundant, its diagnosis may occasionally be very difficult. Under ordinary circumstances complete and extensive dulness, with loss of all elasticity in the chest-wall, of respiratory sound, and of vocal thrill, make diagnosis easy; and if there be resonance below the clavicle, its high-pitched character is very characteristic of fluid below. But there may be no such resonance, and the voice may fail, or fail to set up thoracic thrill. Moreover, vocal thrill and respiratory murmurs may vanish likewise in intrathoracic tumours. Thus the diagnosis between exudations, pulmonary consolidations, intrathoracic growths, and combinations of fluid with either, is sometimes difficult. In acute pneumonia the course of the fever, the expectoration, and other symptoms, may help us to a decision. In pleurisy with moderate effusion the limits of posterior dulness may be changed by a few forcible inspirations, such changes being probably due to a re-expansion of collapsed lung. Moreover, a moderate effusion thus limiting the recoil of one lung may, in the absence of adhesions, permit the heart to be dragged over by the opposite lung. Consolidated lung cannot, of course, be thus modified. In both there may be tubular characters of respiration, which are more easily distinguished in print than at times they may be in the patient. If ægophonic we decide upon fluid, but if bronchophonic we have to distinguish as well as we can between the 'sniffling and metallic' bronchophony of consolidation, and the duller and more diffused bronchial sound of pleuritic effusion. If perchance the dulness and breath-sounds should vary with the position of the patient, fluid is clearly manifest.

Limited effusions, such as an encysted empyema, not large enough to bulge the intercostal spaces, if they do not displace the heart, as most of them do, are at times physically indistinguishable from a like extent of chronic consolidation, or of abscess in the lower lobe of the lung. Such effusions, though usually basic, are by no means always so. Retained by adhesions, they may occupy the upper and anterior region, any part of the middle region, or strips, or irregular districts in any direction; or, again, they may be interlobar—a hard puzzle. It may be said, in general terms, that a permanent *very dull* area remaining after an acute pleurisy or pleuro-pneumonia most probably corresponds to an encysted empyema, but not always. In such cases fever may be entirely absent, and, unless clubbed fingers tell the tale, there may be little to suggest the nature of the disease. Obsolescence may result; still such a collection of pus is very likely to work mischief sooner or later — years later, it may be: the patient rarely escapes with impunity at last. The difficulties of distinguishing the more bulky effusions from pulmonary consolidations are not often great. In the former the intercostal spaces may be bulged, and the moiety of the chest enlarged; but these signs may also occur in some rare cases of caseous pneumonia. On the other hand, it but very rarely happens that consolidation reduces the lung to silence, though this also may be the case; in such a case the bulk of the half-chest would in all probability be lessened, but so, on the other hand, may it be in a chronic pleurisy. The fact is, many chronic cases can only be diagnosed by the needle; and it should be noted that, even with the needle, more than one puncture or two should be made before deciding against fluid. Practically speaking, however, as Dr. Wilks has said, 'chronic basal pneumonias,' unless of subphrenic origin, are so called in error, being pleuritic effusions almost always. Between intrathoracic tumours and large pleuritic effusions a difficulty is found only in those cases in which the tumour occupies a moiety of the chest; this, however, is not very uncommon, especially in cases of aneurysm. If fluid effusion accompany tumour, there may be subtympanitic resonance under the clavicle. In favour of fluid alone are the absence of enlarged veins; the equality of hydrostatic displacement of organs, and the absence of signs of localised pressure—of retarded arterial wave, of inequality of pupils, of peculiar sputa, and of enlarged superficial glands.[1]

A curious pulsation, of uncertain explana-

[1] Dysphagia may, of course, occur in these and in many other conditions; often, for instance, in pericardial effusion, occasionally in pneumonia, and so forth. 'Cancer-cells' are found occasionally in pleuritic effusions, but their absence has no negative value.

tion, is sometimes seen in left-sided empyema, or any effusion, if tense enough, and very rarely also in pneumonia (Graves) alone. In the case of effusion, indeed, the lung must be indurated and must be tied down to the structures about the heart. This pulsation must not be mistaken for an aneurysmal throb. If fluctuation be certainly felt in the intercostal spaces, the disease, in part at any rate, is a fluid effusion. Sometimes a gastric, hepatic, biliary, renal, or other subphrenic abscess, making its way by a sinus, occupies also some part of the pleural cavity or excavates an adherent lung. Such an abscess usually extends rapidly, but it may encyst itself, and remain latent or quiescent for months or years; or it may excite an effusive pleurisy in the remainder of the cavity, so that two effusions co-exist in one pleura. Thus, serum may be withdrawn from one part of a pleural cavity, and a collection of pus may remain encysted in another, a collection very difficult of discovery even when suspected. From it of course pulmonary fistulæ may take their origin, and pus from the same central source—whatever the origin, for instance, hepatic or perihepatic abscess, renal stone, appendicitis, caries of bone, and so forth—may in part issue from the urethra or rectum, and in part issue from the mouth. When such pyogenic cysts contain air, but not by way of the lung, it may be supposed that they have originated in some perforative disease of stomach or bowel; such cases often simulate pyopneumothorax. In these cases, however, there will be little evidence of retracted heart or increased intrathoracic tension, and the affected area will rarely approach the apex. Dulness from disease below the diaphragm, but encroaching on the thoracic space, can often be displaced downwards by a deep inspiration. It is stated that in puncture, combined with the use of a manometer, when the cannula is in a cavity beneath the diaphragm, inspiration is attended with an increase and expiration with a decrease of pressure, being the reverse of that which occurs when the cannula lies in the pleura. In peripleuritic abscess tension is of course low, there is no pressure on neighbouring organs, percussion dulness is less profound, free expansion of the lung can probably be detected, and the axillary glands may be enlarged. It is said (Bartels) that pus from cellular abscesses is of higher specific gravity (1040) than from large cavities (1028–1030). The formation of pus at the bases of both pleural cavities is very suggestive of a subdiaphragmatic origin, and, what would be worse, of the presence of pus perhaps in the mediastinum also. Pleural effusions arising by direct absorption from puerperal and like forms of peritonitis are usually themselves also septic. In respect of diagnosis between serous, sero-purulent, and purulent effusions, it is better to say flatly that without the needle no definite diagnosis can be made. Even in the case of limited recent basal effusions it is better that the physician should understand that he has no positive grounds for assuming that there is not empyema. On the other hand, the signs, such as œdema of the skin, said to be indicative of pus are by no means trustworthy. The chest-wall, again, may be retracted over pus as over serum.

A hæmorrhage into the pleura can be distinguished from a serous or purulent effusion only by a careful survey of all the history and symptoms; the direct physical signs help us but little. Large pulmonary cavities may be taken for encysted empyema with fistulous opening into a bronchus; and here again, as a pulmonary fistula rarely gives rise to tubular breathing, unless the opening be very large, or communicate with a secondary cavity, diagnosis by the direct signs alone might be impossible. The history of the case and the state of the other lung would be important factors in decision. In another class of cases the distinction between chronic phthisis and pleurisy may be difficult—in those, that is, in which there is some old dulness and retraction of a part of the side, with weak respiration and indefinite *râles*, and more or less fever. The absence of bacilli and lung-tissue in the expectoration, and the health of the other side, help to exclude phthisis. Fibroid phthisis, however, is not even thus excluded, and is usually pleuritic in origin. Hepatic hydatids may rise up to the third rib, and in children, enlargement of the spleen, with extension upwards and backwards, has occasionally simulated effusion at the base of the left lung. Finally, the intense distress and orthopnœa of very painful pleurisies—of diaphragmatic pleurisy more especially—may simulate cardiac thrombosis. The state of the pulse alone usually suffices to lessen the fears of the physician.

Prognosis.—The prognosis of simple pleurisy, apart from tubercle or malignant disease, is generally favourable, unless the degree or kind of effusion in the chest endanger life. In children the prognosis is especially good, although in them the effusion is usually pus. If not always favourable, it is because simple inflammatory pleurisies seem sometimes to originate a process of chronic fibrosis, which thence invades the lung. Happily such instances are rare, and in an individual case the chance of such an event almost vanishes. In ordinary inflammatory pleurisies, then, prognosis is favourable; in cases of effusion, where the effusion is moderate, it is favourable; where the effusion is large, it is the less favourable the greater the quantity and the slower the absorption. Signs of hyperæmia and œdema in the working lung must be anxiously watched, especially if an empty radial artery, scanty urine, and other evi-

dences of venous stasis be added. When the chest is full, prognosis is unfavourable apart from operation. In severe and rapid cases the other lung becomes œdematous and congested, bloody and frothy sputa may appear, carbonic-acid poisoning become evident in the blue lips and lethargic brain, the pulse slip away, the heart fail, and the extremities grow chill; or, again, dislocation of the heart and arrest of the pulmonary circulation may cause fatal syncope by asystole or thrombosis. It is said that death may suddenly occur by failure of the respiratory centre even in cases of small effusion; but probably thrombosis of some kind is the ordinary cause of such deaths. Operation, however, raises the hope of recovery greatly—so much so as to put the chances largely in favour of rapid recovery in good subjects. The earlier the relief, the less the damage to the parts and the better the hope of rapid amendment. In bad subjects prognosis will be the less favourable the more potent the adverse conditions; and in pleurisies secondary to other diseases the prognosis will depend but partially upon this one element in the case. In old people operation is still useful, but especial care must be taken to draw off the fluid very slowly, and to watch the circulation. The conditions in them unfavourable to operation are still more unfavourable to absorption. In empyema the prognosis is graver; unless operation be performed death is very probable, either by syncope before the matter escapes, or by exhaustion, chronic septicæmia, or secondary abscesses, during a long period of incomplete drainage of the chest. If operation be submitted to, the prognosis is favourable, save in the worst cases; on the whole, the earlier the operation is performed, after it is fairly indicated, the better the prognosis. Among the deferred dangers are amyloid disease—not a common event, but possible in cases of necrosed rib or other bone, or of long and exhausting drain; and phthisis or more general tuberculosis, happily rare, prevented, it may be, by the density of the false-membranes. The presence of albumen in the urine does not by any means preclude complete recovery, nor forbid prompt operation. The precise bearing of age and sex upon prognosis cannot as yet be decided. Experience indicates that it is more hopeful in cases under ten years of age and above twenty years. Dr. Bowditch says that full pregnancy is no bar to thoracentesis. The influence of diathesis on the progress of local diseases must be estimated in all cases on general principles.

As regards duration, an ordinary case of inflammatory pleurisy will last from ten days to a month, according to the degree of effusion and the rate of re-absorption. Chronic cases with large effusions may last any length of time, rarely less than three months. If tapped, the fluid may not return, or may not return after a second tapping; in such a case recovery will be more rapid. Empyemas, opened under the most favourable conditions, have often been months and even years before final closure; antiseptic operations and dressings have, however, much shortened the average duration. If left to itself, an empyema usually opens through the lung or externally. In the latter case the issue is most commonly about the fifth interspace anteriorly, but may appear elsewhere. Drainage in such cases is very incomplete, and although some relief is attained, the patient nevertheless drags on with a permanent fistulous discharge, it may be for years; recovery without operation is scarcely to be hoped for. Of double empyema many cases have recovered, especially in children.

It must not be forgotten that simple pleurisies may be the forerunners of phthisis. The occurrence or repetition of a pleurisy in a young person of delicate habit or origin is always an alarming thing, and the more so if not due to obvious causes. The experienced physician will call to mind many cases in which a pleurisy, to all appearance wholly recovered from at the time, was followed before many months had passed by definite signs of phthisis. A decided attack of pleurisy, occurring in the course of pulmonary phthisis, always means or makes mischief, even if quickly got under.

Hæmorrhagic effusions, if kept aseptic, often do well; their gravity depends chiefly upon the antecedents in the case. Of secondary foci, which may arise from suppuration within the chest, abscess of the brain is the most calamitous, and, unfortunately, not the most uncommon.

Treatment.—1. *Medicinal.*—Dry pleurisy requires little or no treatment. In some cases, indeed, it may cause distress, as in chronic phthisis; and, if so, may be relieved by spongiopiline and laudanum, or by any similar soothing measures. In the cases in which a troublesome cough is caused by a patch of chronic dry pleurisy, the cough and pleurisy alike may be removed by the application of blisters. In acute pleurisy, however, much depends upon active treatment at the outset; in few maladies is early attention better rewarded, and in few is neglect more surely punished. Our great aim in the beginning is to diminish the pain, the inflammation, the fever, and the tendency to excessive exudation. With or without treatment, as we have seen, the pain usually passes off in forty-eight hours, or thereabouts; nevertheless it is very acute while it lasts. In sharp cases, occurring in healthy persons, we may put on six to twelve leeches according to the age, sex, or condition of the patient, and these may bleed freely into a large poultice. This measure, if adopted at the very outset, diminishes the pain, the fever, the exudation, and the duration of the

case. When the bleeding has ceased, the chest should be firmly bandaged, and so soon as the state of the leech-bites will allow of it the affected side should be as firmly strapped. This, by giving rest to the part, will favour resolution and resorption. Constant respiration, on the other hand, favours effusion, as exercise favours it in inflammation of a joint. If called to a case after the first brunt is over—say after a lapse of forty hours—it is better to omit the leeching, in order that the strapping may be applied at once. It must be carried out on the plan laid down by Dr. F. Roberts, of University College Hospital, which is described in the article REST, Therapeutics of. Dr. Roberts applies the strapping in all cases from the outset. The writer's experience is in favour of early leeching in suitable cases; it may be possible to combine the two remedies, but this at the outset is far from easy, as a large poultice is almost an essential part of the leeching. Some physicians recommend that an attempt be made to subdue the local inflammation by the application of ice-bags, but the results of this method are not very satisfactory. It is said, however, to give great local relief. In addition to local measures, such medicines as the following are required: A combination of compound ipecacuanha powder gr. v, and antimonial powder gr. iij, may be given every six or eight hours, for two or three days. In diaphragmatic and in other cases in which pain is a marked feature, the subcutaneous use of morphine is also to be recommended, in doses of one-eighth to one-fourth of a grain, or possibly more. The fever is rarely severe or protracted enough to require such vigorous antipyretics as quinine, nor is aconite a very safe remedy. It is better to give, in addition to the powder, either full doses of solution of acetate of ammonium (ʒij–ʒiv for an adult), covered with a little milk, or ten grains of salicylate of sodium, every four hours; the latter drug is better avoided in tubercular cases, but it seems to have some power to promote absorption of fluid effusion. An alkaline effervescent may be freely used also as a drink. Thus vascular tension is lessened, and activity of the skin and kidneys promoted. In the earlier stages free purgation should be avoided, but it is well to call gently upon the alvine excretion by the use of mercurials and salines. All solids must be withdrawn from the dietary, and stimulants, as a rule, forbidden. The alkaline effervescent or a cream of tartar drink, with acetate of ammonium mixture, are to be continued after the powders are withdrawn, so as to keep up free excretion; for the same purpose, and also to lessen chest movements, the patient must be kept closely to bed. For some days after the subsidence of the fever the appetite for highly nitrogenous diet must be held in check, and it is desirable at this stage to lessen the amount of fluid in the dietary. Thus it is to be hoped that, as the patient's general condition improves, the effusion in the chest may likewise fall. If this be not the case blisters are to be applied, which, if not pushed to full vesication, may be repeated frequently; or the chest may be kept continuously under the effects of iodine, though this method is less successful than the blisters. At the same time, or soon after, a pill may be administered twice daily, containing a grain each of digitalis (fresh leaf) and blue pill. A grain of squill may be added, but squill has some tendency to disorder the stomach. The use of both blisters and mercury must, of course, be avoided if the kidneys be not sound, and mercury should be avoided in any case where a phthisical tendency is suspected. Iodine may be applied externally. When a brief and gentle eliminative course of this kind is ended, it is well at once to turn to the full tonic treatment, with such drugs as iron and quinine. Less active effusions in delicate and anæmic subjects may need iron and bitters, cod-liver oil, and liberal diet from a very early stage, and such cases are common. At the same time such measures are not to be used while the more acute stages are present—a precaution too often forgotten; for even in phthisis a sharp intercurrent pleurisy must often be treated by salines, and possibly a leech or two at first.

These measures will generally succeed in reducing not only an acute effusion of moderate extent, but also many effusions of a more obstinate kind. If, however, the case resist the means prescribed, the effusion will probably increase, and may need operative interference, as is so commonly the case in latent pleurisy. As a general rule, if an effusion rises much above the angle of the scapula, and abides in this quantity or more for two or three weeks in spite of adequate treatment, it must be drawn off, whether the patient be embarrassed by it or not.[1] In cases in which treatment by medicines has not been fairly tried, when the patient is in comparative ease, the effusion is not above the spine of the scapula behind nor above the mamma before, is not rising fast, and the neighbouring organs are not seriously displaced, operations may give place to medicinal treatment for two or three weeks longer. The writer, however, would advise the withdrawal even of a pint of fluid which had lain in the cavity for a month, as its continued presence promotes collapse of the lung, and tends to destroy the absorbent power of the pleura and of its granulations.

[1] In the revision of this article these words are left as formerly written. The writer is well aware that of late recourse has been had earlier and more frequently to paracentesis; but his own experience leads him still to counsel delay so long as the patient is in no distress. Under ordinary circumstances serous effusions advance to a moderate limit, and then slowly recede.

It is needless to add that, if there be effusion in both pleural cavities, the amount in both must be considered as one quantity. Before speaking of operation, however, it is well to say that two more methods remain—the so-called 'thirst cure,' which has some good effect in the treatment of serous effusion; and the jaborandi cure. The first method consists in the withdrawal of fluid from the diet, which should be as dry as possible, and consist of lean cold meat, stale bread, and the like. All fluids are forbidden, except half a pint on the third day, and a pint on the seventh and eighth days. The effusion is said under this method to decrease daily; the method, however, is more painful than tapping, and could not be borne by all patients without injury. The second plan consists in the promotion of profuse sweating, by means of jaborandi. Excellent results are said to have followed this method. The drug may be administered as a liquid extract, ʒj being given every three hours; or one-third grain of nitrate of pilocarpine may be injected subcutaneously, and repeated as the results may indicate. If medicinal and dietetic means fail to remove a moderate effusion, if the fluid be rising fast, or if it already occupy the whole or a great part of the pleural cavity, the cavity must be tapped. There should be no hesitation in tapping instantly any chest which is dull up to the clavicle, or which presents but a small tympanitic space under the clavicle. The operation of removing fluid from the chest by tapping (paracentesis thoracis) seems to have been practised in early times, but did not become familiar to us until the last quarter of the present century.

2. *Operative.*—It may be a matter of doubt whether the fluid contents of the chest be serous, sero-purulent, or purulent. To ascertain this an exploring syringe may be passed through the wall of the chest, and a specimen of the fluid drawn off. In this way information is obtained as to the nature of the fluid, and its accessibility. Should the tap be dry, it can be repeated at another spot more readily, and with less sense of failure, than a greater operation. The precise place of operation must, of course, be chosen with great care; but, happily, there is plenty of margin for error; in an encysted empyema with thickened walls four or five punctures may be needed before pus be reached, and the negative result must not be accepted without projecting any drop or fragment which may be within or about the needle upon a slide, and examining it under a microscope. If the issue be serous, the complete emptying of the cavity is not necessary, and not always desirable. In cases of multilocular pleuritic effusion the emptying of one cavity only is of course an incomplete measure. Such cases are unsatisfactory at best, and can only be tested by repeated puncture.

If there be no special reason to the contrary, the chest is to be tapped on the lateral or posterior aspect, as there is thus less danger of interference with other organs. Reasons to the contrary may present themselves in the case of adhesions tying the lung or diaphragm to the side or back of the cavity, of lateral displacement of the heart in left-side effusions, of deformities in the individual, and so forth. The pointing of an empyema forward, however well-marked, is no indication for an anterior opening, as this pointing will recede when a posterior opening has been made; nor is the faintly audible sound of respiration over the back of the affected side a reason for declining to operate posteriorly, for such faint sounds are often conveyed to the ear when the cavity is full of fluid. Let a minute scrutiny then be made of the lateral and posterior aspects of the chest. Let any bulging of intercostal spaces be looked for, as at such a spot false-membranes are probably scanty or thin; and let the ribs be minutely examined, in order to ascertain that there is room enough between them for the insertion of a finger into the cavity, if this prove to be needful; or that, in any case, resection of a rib may, if possible, be avoided. The eighth space in a line with the angle of the scapula or a little outside is the best position in ordinary cases. If it should appear, however, that the fluid is so limited or encysted that it does not gravitate to the bottom of the cavity, or that it has a more anterior seat, a tentative puncture must be made at the dullest spot, regard being had, of course, to the position of neighbouring organs.

After careful disinfection both of the skin and of instruments, the needle must now be thrust quickly through the tissues into the cavity, the operator being careful to take the mid space, and thus to avoid the periosteum of either rib, and the intercostal artery. There is no objection to freezing the skin beforehand, but if the edge of the cannula present no ridge upon the trocar the stab is not very painful. If the fluid drawn be clearly serous, and the patient be a child, or the syringe capacious, it may be well, if time press not, to wait a day or two to see whether this small draught will set up absorption of the rest. Many such cases are on record. As a rule, however, it will be needful to proceed to a further evacuation of the cavity. For this a special instrument will be needed.

We cannot enter into an account of the many instruments sold for paracentesis thoracis; almost any one of them is satisfactory. They all consist in a fine trocar or perforated lance-headed needle, with an exhausting apparatus attached thereto.[1] Pumps of various makes are adapted to the

[1] The hollow needles sometimes used have many drawbacks. They may prick the lung and cause cough or even let air into the pleural cavity, which, if not septic, may prevent expansion of the lung.

trocars, by which the pressure of the atmosphere or the choking by clots may be counteracted. These pumps are rather cumbrous, and they are liable to be worked at an excessive pressure. The best exhaust in ordinary cases is a column of the fluid itself, which can be set higher or lower, as the run of the fluid seems to indicate. This column is formed by attaching a long indiarubber tube, at least four feet long, of small calibre but of substance thick enough to prevent collapse, to the collar of the cannula, and its height is varied by elevation or subsidence of the basin of water in which its distal end is placed. This tube has, of course, the action of a siphon, and by it alone, in the vast majority of cases, we can overcome the resistance. The diameter of the tube should be small, or the fine cannulas now in use for paracentesis will not feed it; moreover, the slower the issue of the fluid the better. It is well to attach the tube to a short branch of the cannula issuing at a small angle from the side of the latter, and containing a stopcock; in such an instrument the trocar works like a piston in the cannula, and can only be withdrawn to a point immediately beyond the opening of the lateral channel. The advantage of this arrangement is that we have in the tap a ready and convenient way of commanding the flow, and on stoppage of the cannula the trocar can at once be so pushed up as to clear it. If there be no piston-trocar the cannula has to be cleared by wires —a fidgety process, and too often inefficient. It may be better indeed under such circumstances to close the wound and re-introduce it elsewhere; thus less pain and annoyance is felt in the end, and a better result obtained. A disadvantage is that such an instrument is not very easily purified, and as inflammatory serous effusions are certainly liable to turn into pus if septic elements be admitted to them in the smallest quantity, the instruments used must be scrupulously disinfected and air excluded. If the distal end of the delivery tube be placed in water, and the tube be emptied by running the finger down it, any bubbling after the expulsion of any residual air will almost certainly point to wound of the lung. The tap should be turned when the patient is quiet and at the beginning of his expiration. The fluid will run at first in a steady stream, afterwards in gushes corresponding to the expirations. When the fluid ceases to run, or coughing grows troublesome, the tube may be withdrawn; for if the fluid be serous the presence of a remnant, or more than a remnant, of the effusion in the cavity is of no disadvantage; if it be sero-purulent the cavity is certain to refill, and if it be laudable pus it will in all probability refill. On the other hand, when the lung expands imperfectly, to exercise strong suction upon the mediastinum or on the abnormally vascular pleura is to run the risk of doing harm. The patient must either sit up, or take a semi-recumbent position towards the sound side, with the shoulders raised upon pillows. If there be any tendency to syncope, an erect position will aggravate it, and a recumbent position is unfavourable to operation and to escape of fluid. The patient must be closely watched, and the stopcock turned in case of severe coughing, which may be very tiresome and attended by profuse watery excretion—probably the consequence of pulmonary œdema intensified by the siphonage. The least sign of faintness will of course call for the same precaution, but, happily, this is rarely seen. Cases are reported in which sudden death has occurred during paracentesis, or about the time of it; but cases of sudden death are not uncommon in pleuritic effusion, whether punctured or not.

It may be desirable, if there be no indication to the contrary, to inject one-fifth of a grain of morphine beneath the skin after the operation, in order to relieve any irritation either by cough or otherwise, and to secure subsequent rest. The stopcock of the instrument will, of course, be shut when the cannula is withdrawn, and the puncture promptly closed on withdrawal by the finger. It is well to keep the finger in apposition for a few minutes, and then to apply a simple antiseptic lint-pad with short strips of plaster. In some favourable cases no second tapping is needed, and the heart tends to recover its position on the completion of the operation, moving three inches perhaps in the course of it. In two cases in which the writer noted reduplication of the second cardiac sound before tapping, the sign ceased at once on the emptying of the cavity. In other cases, even of serous effusion, the severity of the pleurisy may have so fettered the lung that the re-adjustment of the parts is much more gradual, and the space of the effusion is re-occupied but slowly by the unfolding lung, and the yielding of the chest-wall and mediastinum. In this respect there is not much difference between serous and purulent formations, save, of course, that neglected cases are more likely to have become purulent. A rapid return to the normal of the physical signs is a very good omen, and in cases promptly dealt with is now happily a common experience. In cases which recover more slowly we get less help from the physical signs, the conditions within the chest being in a more stable state of perversion. In pleuro-pneumonia the lung may not be able to expand in case of paracentesis for the pleurisy, so that only some ten ounces or so may be obtainable by falling in of the ribs. It is rather the rule than the exception for some dulness to remain below the scapula, and this alone is no indication for repeating the operation. In the majority of cases, however, the cavity refills, and aspiration

may have to be more than once repeated. It is proper, therefore, to warn the patient beforehand of what may be in store for him. The injection of a solution of chloride of sodium ($\frac{3}{4}$ per cent.) has been said to promote re-absorption and avert re-tapping. The same end is said to be attained also by the introduction of sterilised air after removal of all the fluid possible. These methods, however, have not yet proved their claim to acceptance.

If there be any subsequent pain or elevation of temperature, these, under ordinary circumstances, will prove to be transient. If the rise of temperature continue after the first day or two, the formation of pus is to be feared. This event, moreover, is not infrequently attended with a reawakening of pain. In a case of extreme illness it may be desirable to draw off a certain quantity of a purulent effusion by ordinary tapping before proceeding to any further operation, as in this way any danger due to the sudden emptying of the whole cavity by the radical operation is avoided. Moreover, in young children aspiration might possibly suffice. As soon as possible, however, in all adult cases, the pus must be evacuated by free incision. But in all ordinary cases incision must be practised at once on the discovery of pus in the pleura. An anæsthetic must be used, and the operation deliberately performed. Chloroform in these cases seems to put less strain upon the limited breathing powers than ether; it need not be pushed far. If for any reason general anæsthesia be undesirable, it may be obtained locally by one of the sprays having this power, or by pressing against the part a lump of ice previously dipped in salt. If the patient be of spare body, let the opening be taken a little outside and below the angle of the scapula —say, in the eighth interspace, which site is above the line of an adherent or drawn-up diaphragm; if he be stout and muscular, a more lateral operation may be preferred, though drainage is more continuous and thorough by a posterior opening, and the ribs are there less liable to fall together. A scalpel is first thrust straight through the chest-wall on the upper margin of a rib, a grooved director is inserted alongside of the scalpel, and the incision is enlarged with a curved probe-pointed bistoury to the size of an inch or an inch and a half. Some surgeons recommend that incision be carried so far as the pleura only, and the latter forced open by dressing forceps.

It is, we repeat, of the greatest possible importance that all the instruments in use be disinfected, and the whole operation and dressings carried out on the antiseptic method. From the time of the operation the temperature should fall rapidly to the normal; if it rise again, the rise will be almost surely due to occlusion of the opening. To prevent this we insert a short, stiff drainage-tube. False-membranes as thick as wash-leather may oppose themselves at first, and the tube therefore should be proportionately large; but these soon break down into curdy shreds, and the tube may be then reduced in diameter. Injections of a simple or antiseptic character into the cavity of empyema are, in the writer's opinion, to be avoided. They are rarely of use, they often increase irritation, and are sometimes attended with distressing or alarming general symptoms.[1] The great secret is to secure free and complete drainage; if this be attained the cavity will purify itself. This is as true of closing cavities as of freshly opened cavities; for to inject sinuses, in the hope of procuring adhesion and closure, rarely succeeds and often does harm. In like manner, to probe the opening of an empyema is generally a mistake. If the opening discharge for a long period, it may be well once for all to ascertain the length and direction of the sinus; but it is better to enlarge the opening if necessary, or even to make another, than to fret the part by repeated explorations. Resection of a portion of a rib has been recommended by some surgeons, even as a part of the ordinary operation. If a neglected empyema have shrunk or discharged spontaneously, if the ribs have come into contact, or if, after opening, the continuance of the discharge seem to depend on rigidity of the chest-wall and carnification of lung, then resection of considerable portions of several ribs on Estlander's method may carefully be considered by the surgeon. But the practice of resection in ordinary cases is unnecessary and meddlesome.

In the exudations of tuberculous or carcinomatous disease, operation may be justifiable by the temporary relief given to the sufferer; paracentesis must, however, be preferred to incision as long as possible, as the incision is not likely to close. If after the removal of a collection of pus, and the establishment of really free drainage, the discharge become more offensive and the fever remain, the disease is probably tubercular and the forecast of the worst. It will be remembered, however, that the pus may not all be included in one cavity or in cavities which communicate. It is needless to say that each separate cavity will need its own operative relief.

Sometimes empyemas have been treated by repeated aspirations, instead of by incision and continuous drainage. It is hopeless to attempt the cure of a sero-purulent discharge by this method, but a collection of laudable pus once removed by the aspirator has in rare cases failed to return. The chance of success by this method, even in young children, is too slight to be looked for with any

[1] Jeanselme has collected forty-five such cases in *Rev. de Méd.*, July 1892.

confidence, and the repetition of these aspirations does not prevent the gradual condensation of the lung, nor the formation of a pulmonary fistula. There is no difference in method between the performances of these operations in childhood and in age, but in childhood recovery is generally more rapid and sure. Nor is there any difference of method in operating upon a case in which a pulmonary or other ill-placed fistula has already formed; nor is the performance of the operation much the less urgent in such cases, even if the bronchial opening be free and not valvular. In rare cases it may be possible to drain a pyopericardium through the pleural opening.[1] In cases of double empyema a day or two should, if possible, be allowed to intervene between the two operations, especially in children; there is no small risk of collapse or of pulmonary œdema in doing both operations together.

It is desirable that after each or any removal of fluid from the chest the re-expansion be assisted by respiratory gymnastics. The best method of obtaining this end is by graduated exercise; by the inhalation of compressed air; or by residence at high elevations. Massage and faradism will be found necessary under such circumstances.

Means have been proposed by which the entrance of air into an empyematous cavity under drainage might be prevented, and the lung thus helped to expand under inspiration. The need of absolute freedom in draining and dressing, however, must discourage the use of all complex apparatus; and if the operation be performed early and antiseptically, it is marvellous how well the lung will recover itself.

3. **Pleura, Air in.**—Synon.: Pneumothorax; Fr. *Pneumothorax*; Ger. *Luftbrust.*

Definition.—Pneumothorax, as its name imports, is the state in which the pleural cavity, normally vacuous, or rather non-existent as a space, contains air or other gas without intermixture of liquid. If air or gas be present together with pus, blood, or a watery fluid, we give to the resulting state the compound names, *Pyopneumothorax*, *Hæmatopneumothorax*, and *Hydropneumothorax* respectively. The gaseous contents in these cases may precede the entry of the fluid or succeed it, and in the latter case it may perhaps be developed as a product of decomposition. These conditions, though not wholly unknown to the predecessors of Laennec, nevertheless were first adequately distinguished and clinically demonstrated by him.

Ætiology.—Pneumothorax is a commoner event than would be supposed, were we to confine our attention to cases which are recorded under this name. It is often an incident in the course of other diseases, and of none more often than phthisis. Pneumothorax sometimes, but rarely, appears as a primary event, and disappears again without further complication; more usually it occurs as one result of wounds of the chest, of purulent pleuritis, of phthisis, or of some rarer disease, such as ulceration of the œsophagus, stomach, or gall-ducts, carcinoma, and the like, which effect an opening into the cavity. If air be mechanically admitted to the pleural cavity, decomposition of other contents may add to the volume of that which was admitted. Even in those few cases in which pneumothorax seems 'idiopathic'—in which, that is, we find pneumothorax to be the first, the sole, and the last morbid state—we are almost bound to assume that this state is, in fact, secondary, and due to some perforation the cause and place of which escape our search. That such cases do occur is unquestionable; the most frequent cause being a strain, noticed or unnoticed at the moment. One such case, in the writer's experience, was due to a strain at the oar, another to a strain during gymnastics, a third to some unknown cause. All three subjects were vigorous men, and soon recovered on expectant treatment. In passing to the cases of more obvious causation, those due to wounds of the chest are the first to meet us, and need not detain us. That any wound perforating the wall of the chest and the pleura may permit air to be drawn by suction into the pleural cavity is obvious.

Of the same kind, but of reverse origin, is the pneumothorax which in empyema often but not necessarily follows perforation of the lung with ejection of the pus upwards, or less often perforation of the chest-wall by ulceration outwards. In these cases of pyopneumothorax we have to deal, of course, with the presence both of pus and of air in the pleura. Pneumothorax is not infrequently met with as a complication of phthisis pulmonalis. It occurs for the most part in the later stages of the disease, and often escapes observation; less frequently it is met with in the earlier stages, and is then betrayed at once by its symptoms. Its occurrence may be aided or not by such a strain as a fit of coughing. That pneumothorax is not a mere uniform result of ulcerative processes in the lung is due, of course, to the anticipation of a breach of surface by previous adhesive inflammation. In phthisis, happily, the perforation as a rule is minute, and the quantity of matter escaping into the cavity small—so small as to be generally inadequate to produce the physical signs of fluid contents. In other cases the escape may be more abundant, or a more abundant effusion comes from the pleura itself, as a consequence of the resulting irritation. We

[1] *Cf.* Sir W. Savory, *Med. Chir. Trans.* vol. lxvi. p. 235; and Mr. Godlee, *Brit. Med. Journ.* Oct. 15, 1892, p. 830.

then have to deal with an obvious hydro-pneumothorax, or pyopneumothorax. The opening by which air escapes into the pleural cavity may be, and often is, valvular, so that its entry during inspiration may not be balanced by its exit. In this way air may accumulate under pressure. If, as in empyema, the lung be already collapsed, this pressure is the less distressing; if the lung be wholly or in part open, the pressure adds to the degree of the sudden embarrassment due to rapid collapse of lung, and to encroachment upon the surrounding parts, including the opposite lung. Air thus entering the pleural cavity is often purified from septic elements by its filtration through the lung, unless it pass through cavities and alveoli already charged with septic matters. In puncturing the chest-wall with a fine trocar, in cases of serous effusion, the lung is sometimes wounded, and air escapes into the pleura. The accident is an untoward one; but the air which thus escapes into the pleura is so cleansed by its passage through a healthy lung that, as a rule, it sets up no putrefaction, and is itself quickly absorbed. The puncture heals too rapidly to permit of any continuous transpiration, but the quantity suddenly admitted may add a good deal to the suffocative distress of the patient. A similar state of things is not uncommonly seen in the practice of the surgeon, when an injury which breaks a rib also drives its broken point or points through the costal and pulmonary pleuræ.

It is said that in emphysema the bursting of dilated lobules may set up pneumothorax, and we may wonder that this event should be so rare. Perforation into the pleural cavity by ulcerative, cancerous, or other destructive changes, either in the lung itself or such neighbouring organs as the œsophagus, the stomach, the bowel or connected ducts, is not very rare in cases of malignant disease; and the entry of air, food, or other foreign matters into the pleura sets up suffocative and inflammatory symptoms, which add greatly to the miseries of the last days of life. There are, no doubt, other kinds of disease by which air may find its way into the pleural cavity; but the above description, with little or no essential difference, will apply to all.

Anatomical Characters. — Under this head we have little to say in respect of pneumothorax, and we have not here to deal with the further appearances of hydrothorax or empyema. A patient would rarely die of simple pneumothorax; for if death be mainly due to this, yet unless it occurred within the first few days it is probable that some degree of inflammation would follow the disturbance. In the vast majority of cases, of course, the pneumothorax is secondary to some other disease, and any fluid or other matters found with the air in the chest may be due, not to the mere admission of septic air into the cavity, but to the admission of decomposing elements into it. As concerns the presence of air alone, we have only to say that in most cases—especially in the cases in which air has reached the pleura by a valvular opening—the affected side of the chest may be visibly distended. In such a chest the pressure of the contained air may well be not negative only but positive, and on puncture the imprisoned air may escape with a hissing noise; if the air be contained under high pressure, the out-rush may be very strong—strong enough to blow out a candle. This air is usually deoxidised, and rich in carbonic acid; if there be decomposing matters in the cavity, it is likely also to contain sulphuretted hydrogen. Neighbouring parts will be found more or less dislocated directly as the degree of compression of the contained air, and inversely as the amount of adhesion limiting its extent. Bilateral pneumothorax of great extent is, of course, incompatible with life; if on necropsy it be found double, we may be sure that, on one side at any rate, it came on at the moment of death.

Symptoms.—The symptoms of pneumothorax are of course the more distinct the less the symptoms of the primary malady. In those rare cases in which pneumothorax comes on apparently as a primary disease—that is, in which the mode of entrance of air into the pleural cavity is most obscure—we find the chief symptoms to be dyspnœa and a sense of faintness, pain being a less uniform symptom, and present only when the entrance of air is followed by irritation and inflammation from the fluid or solid matters which accompany the gaseous. Aseptic air alone does not set up inflammation, nor much irritation. Fever, in like manner, depends not upon the entrance of air, but of the irritating matters which accompany it, and excite inflammation. It may, like the pain, be considerable; it may not be present at all; or, again, it may be lost in the fever of the primary malady, or show itself but as a slight exacerbation of that fever. The dyspnœa, in part mechanical, in part probably reflex, is necessarily attended by increase of pulse-rate; the two events being but different aspects of the same machinery. The degree of these accelerations, as has been hinted, depends upon the amount of previous accommodation in the chest, and upon the quantity, if any, of fluid and solid concurring with the gaseous escape. The escape of air with irritating matters suddenly into the pleural cavity of a person suffering but little from a phthisical ulceration, or of one surprised by an accident in the midst of health, will cause dyspnœa almost suffocative in degree, faintness, great acceleration of the pulse, and intense pain. If the affair be more serious there may also be symptoms of collapse, including a fall of temperature, cold

extremities, ashen face, colliquative sweats, and chill breath. On the other hand, in pneumothorax occurring towards the end of phthisis, when a pulmonary ulcer breaks into the pleura widely adherent about a lung already half-obliterated, an attack of chest-pain may follow a bad fit of coughing, and be often put down, like the dyspnœa and the pulse-rate, to the fatigues and distress of a restless night. The patient's general condition may not be very markedly altered in such cases, and the pneumothorax is often overlooked. Cough and expectoration of course assume no proportions in simple pneumothorax; but if pneumothorax be established on the bursting of an empyema into a bronchus, it is obvious that cough and expectoration will be the most prominent of the symptoms. It is well to remind the reader that emphysema of the skin may result from the breach which causes the pneumothorax, or on the other hand may be present without pneumothorax, even in cases of fractured rib, and in cases of interlobular emphysema passing to the neck by way of the mediastinal tissue.

The *physical signs* are as follows: The affected side, in well-marked cases, may be enlarged in girth and of a rounder form. It is, moreover, still in respiration, the half of the chest being fixed (probably in the inspiratory position), or only dragged a little by the efforts of the accessory muscles. Air, like fluid, may press down the diaphragm, thrust the mediastinum aside, and change the place of the heart. The lung of the affected side will tend, of course, to recede to the point of the equilibrium of elasticity. In other cases, as in pyopneumothorax with retraction, the affected side often falls in so as to be of less girth than the sound side. Vocal fremitus must be absent if the lung be wholly collapsed, or far removed from the wall of the chest; if the lung be adherent in part to the chest-wall, vocal fremitus may be proportionally perceptible, and it may be possible to ascertain by other methods how far, if at all, the lung is adherent. Decubitus is usually on the affected side.

Percussion gives us great assistance in the detection of pneumothorax, the sound being tympanitic everywhere where lung is not, by adhesion or repression, kept in contact with the chest-wall, and often extending beyond the normal boundaries of the affected side. There is something about the loud, low-pitched, and extensive, if not definitely tympanitic, vibrations of the stricken chest in pneumothorax which is very characteristic. On the other hand, it is said that if the pleura be tightly distended by air under high pressure the percussion note may rise to positive dulness; the presence of fluid will dull the percussion considerably or altogether, in districts which will vary with the quantity of fluid and the position of the patient. In pyopneumothorax, with a bronchial fistula, the sharp line between hyper-resonance and dulness may be changed after a profuse expectoration. By percussion with palpation the dislocation of neighbouring parts and organs may be ascertained. The auscultatory phenomena of pneumothorax are curious, and were known even to Hippocrates. If we confine ourselves to pneumothorax pure and simple, auscultation is generally almost negative; in rare cases we may detect by a blowing (amphoric) sound the entrance and exit of air by a free opening, but in such cases fluid is always present as well; a few resonant *râles* may also be heard, especially near the shoulder-blade. The voice-sounds also and the cough may be more or less amphoric. Vesicular breathing is never heard. In pneumothorax, there is often present the peculiar phenomenon called the *metallic ring*. After death this metallic echo is always to be obtained, but during life the increased tension of the gas at the higher temperature may prevent it. In addition to this a very clear cracked-pot sound may be heard in some cases of pyopneumothorax with a wide fistula. The metallic tinkle of succussion, which was known to Hippocrates, consists in the echo of splashing or dripping fluid in the air-containing pleural cavity; and indeed other sounds generated inside the patient, such as the heart-beat, cough, &c., may take this metallic consonance from the chest-cavity, and may betray pneumothorax or illustrate it. In the same case, at different times, such sounds may be heard, or may be inaudible—variations which are, perhaps, due either to mechanical conditions dependent upon adhesions, the formation of false-membranes, the shape of the cavity, or the tension of the contained gases. *See* PHYSICAL EXAMINATION.

DIAGNOSIS.—The diagnosis of pneumothorax by the signs and symptoms above named is not difficult, if its occurrence be sudden, and the patient not too ill to forbid examination. If the presence of adhesions prevent the development of these symptoms, the case may be more obscure, but by so much the less serious. As, on the one hand, in an enormous moist cavity it is conceivable that metallic and succussion sounds may be heard, so, on the other hand, pyopneumothorax, restricted by adhesions to small dimensions, might simulate a cavity. Indeed, diagnosis might be impossible in such cases, but, speaking generally, the dulness and retraction of the chest-wall over a cavity would assist the diagnosis. Distension of the stomach, with elevation of the diaphragm, or diaphragmatic hernia, could scarcely be mistaken for pneumothorax by anyone who fairly took into consideration all the facts and history of the case. As empyema, especially in children, may lead to purulent pericarditis, so may pyopneumo-

thorax by perforative process have pyo-pneumopericardium added to it. Emphysema of the lungs gives rise to tympany sometimes as great as of pneumothorax. Emphysema, however, is always two-sided, and rarely dissociated from sibilus or other sign of open bronchial tubes. In cases of pyo- or sero-pneumothorax there may be great difficulty in determining the quantities of fluid and of gas respectively in the cavity; so much as three quarts of fluid may co-exist with a great deal of resonance above it. Tapping alone could decide the matter, and in such a case would probably be indicated.

Prognosis.—This obviously depends so largely upon the causes and concomitants of the pneumothorax, that any general directions are impossible. The tendency of air in the pleura is to absorption. The prognosis of chest-wounds, of phthisis, of empyema, contains differences too wide for formulation. It is asserted that pneumothorax, by the sudden oppression of the lung through the indrawn air, may cause rapid and even sudden death.

Treatment.—The treatment of pneumothorax in like manner must depend greatly upon the nature of the primary malady. In pyopneumothorax from empyema operation is the first necessity in a patient of sound constitution. Whether, in any given case of phthisis, pyopneumothorax should be dealt with by operation may become a question—a question usually, but by no means always, to be decided in the negative. Still, cases do occur in which the volume or character of the effusion, and the chronicity of the lung-disease, may outweigh the risks of operating; aspiration should be tried alone in the first instance. In wounds of the chest-wall, or of the pulmonary pleura, the puncture rarely closes so soon as to imprison the air in a state of higher tension than the atmosphere. Such a thing may occur, however, especially with valvular openings, and the displacement of organs and respiratory distress may indicate that relief is urgently needed. If it be, a fine trocar may be inserted into the chest, and by means of a tube air may be permitted to escape through water or under antiseptic dressings until equilibrium is re-established. The hypodermic use of morphine is as valuable in soothing the pain and distress of pneumothorax as of like suffering elsewhere.

4. Pleura, Dropsy of. — Synon.: Hydrothorax; Fr. *Hydrothorax*; Ger. *Brustwassersucht*.

Definition.—As the word implies, this is the term given to simple aqueous effusions into the thoracic cavity.

Description.—Hydrothorax is not to be classed with the effects of inflammation, but with dropsies elsewhere, and is the companion in many cases of ascites and anasarca. In other cases it exists alone, but is rarely confined to one side of the thorax, and perhaps never exists as a sole malady. We may say generally that it is liable to arise under the following circumstances: when the whole circulation is so impeded that venous pressure is increased—as, for instance, in disease of the mitral valve or its orifice; when venous arrest is due to some local causes, as, for instance, to the pressure of localised swellings upon veins, or to venous thrombosis; when the bronchial glands are enlarged; when in renal disease the removal of water from the system is checked; or, finally, when the quality of the whole blood is so deteriorated by disease, or the circulation is so changed by cold, or other such general influence, that its serum tends to exude passively from the vessels. In the first and third cases we should expect to find dropsy in both pleural cavities, in the second case the transudation might be limited to one of them. On the other hand, it is to be remarked that such transudations rarely stand at the same height in the two cavities, and indeed the contents of one of them is often so small in volume that the hydrothorax may seem to be unilateral. As a matter of experience, hydrothorax is chiefly seen in diseases of the heart and kidneys, in scarlet fever without renal affection, in septic and other diseases of the blood, and in the cancerous and other cachexias, whether there be local disease of the pleura or not.

Diagnosis. — The diagnosis of hydrothorax and its measure are easy, except in a few cases where the effusions are restrained by adhesions. The lung moves more readily than in pleuritic effusion, the diaphragm often retains its normal relations, the line of dulness does often shift (while in inflammatory effusion it practically does not), and vesicular breathing may not be absent.

Treatment.—Hydrothorax in the majority of cases is not formidable in itself, and (being not uncommonly an event of the last days or hours of life) is perhaps only noticed at the necropsy. Diuretics and hydragogue purgatives act more readily in hydrothorax than in inflammatory serous effusions. Still, if it increase so far as to harass the breathing or to add to the dangers of the disease, the fluid should be drawn away by a fine trocar without any fear of purulent change. It is well, however, to prevent the entrance of air into the chest, lest the fluid have in any degree an inflammatory nature, as it may well have, for instance, in scarlatina or nephritis. The operation may be repeated a great number of times if re-accumulations make it necessary. The fluid, if wholly non-inflammatory, appears as a greenish or yellowish transparent water; it contains no clots nor does it coagulate in the vessel; it may not contain corpuscular elements. It contains albumen, and its specific gravity is about 1008°. The presence of a corpuscular

precipitate, any turbidity of the fluid or tendency to coagulation, will at once suggest a degree of pleuritis. In heart-disease with much venous stasis or much arterial degeneration, the effusion is not rarely tinged with blood.

5. **Pleura, Hæmorrhage into.**—Synon.: *Hæmothorax.*—Bloodstained effusions may occur, as we have said, even in simple pleurisy, but more commonly in such conditions as scurvy, tubercle, cancers, and the like. A purely sanguineous effusion is generally the result of wounds of the chest or its viscera; but it may also arise from within, as from rupture of the heart or of an aneurysm, or from a bleeding cancer. The means of examination or treatment of such cases, in so far as these are possible, may be gathered from the preceding sections. Hæmorrhage into the pleura from direct extravasation may be left awhile, on the chance of re-absorption. If this does not seem on the way, a tentative puncture may be made. If the issue be ichorous the patient will probably become febrile, and the major operation be needed sooner or later.

6. **Pleura, Morbid Growths in.**—The pleura enjoys no complete freedom from the invasion of sarcomatous or carcinomatous growths; but growths of the former class are very rare, except as intrusions from neighbouring parts. Cancer is found less rarely. The frequency of mammary cancer, and the neighbourhood of the pleura to the breasts, increases the danger of secondary mischief in the former part. Pleural mischief is, indeed, a common consequence of mammary cancer, and may be the fatal conclusion of a case. It occurs after or before operations of excision. From the cancer in the wall of the chest simple inflammation often extends to the pleura, and produces the usual results. In other cases the cancerous growth is itself propagated to the costal pleura, and spreads from thence. The cancer is usually seen in the form of small flattened or rounded elevations, rich in blood-vessels. If septic matters escape into the pleural cavity its effusions may soon become putrid. It is said that a rapid degeneration of cells, either cancerous or tubercular, may give rise to a quantity of fat-droplets so great that a layer of fat may be seen to stand on the top of the serosity withdrawn by tapping. Blood, too, easily issues from highly vascular formations—whether cancerous, tubercular, or simply inflammatory; and may be seen in the fluids after withdrawal.

There is little to be said of the symptoms and signs of such cases that will not be found under the more general heads of Lungs, Morbid Growths in; Mediastinum, Diseases of; and 2. Pleura, Inflammation of. The diagnosis of cancerous or other such masses from their own effusions or from simple effusions, let it be frankly repeated, is sometimes impossible without the needle. The prognosis in such cases will not depend upon the pleuritic changes alone; and the only remark to be made on their treatment is that paracentesis, in the secondary effusions, is not wholly to be declined. Some such patients have obtained from repeated puncture not only a prolongation of life, but also great relief of suffering.

Hydatid of Pleura.—Hydatid is rarely met with in England either in pleura or lung, and in either place occurs rather as a secondary than as a primary event. The most common source of thoracic hydatid is the liver, whence it tends to invade rather the right side of the chest, and may rise nearly to the clavicle. In some cases, when the cyst is comparatively small and unbroken, its nature may be suspected from its position and outline.

In other cases, and especially when the cyst has ruptured into the pleural cavity, physical diagnosis can give no distinctive evidence, and we have to make what we can out of the history and other circumstances of the case.

In view of operative interference, it may in a few cases be needful and possible to distinguish hydatid of the pleura from hydatid of the lung, but this is a question rather for discussion in connexion with pulmonary diseases. Pain would suggest pleural relations, and if a small cyst lie deep in the lung tubular breathing might be audible in the partially compressed overlying lung-tissue. When a hydatid cyst breaks into the pleural cavity, its treatment falls under the ordinary rules of pleuritic effusion, but aspiration alone will rarely suffice for a cure.

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PLEURODYNIA (πλευρά, the side; and ὀδύνη, pain).—Synon.: Intercostal Myalgia; Fr. *Pleurodynie*; Ger. *Seitenschmerz.* A name for muscular rheumatism or cramp affecting the chest-wall. *See* Chest-Walls, Morbid Conditions of; Cramp; and Rheumatism, Muscular.

PLEURO - PNEUMONIA. — This compound word signifies a combination of inflammation of the pleura and of the lung itself. In all cases of acute pneumonia there is a certain degree of pleurisy corresponding to the inflamed lung; but it is of little or no practical significance, there being only some exudation on the pleural surfaces. Pleuro-pneumonia implies that the two morbid conditions are actually associated in various degrees, giving rise to their respective pathological changes, and each thus influencing the symptoms and physical signs. Indivi-

[1] The writer has to acknowledge the valuable help of Dr. Wardrop Griffith of Leeds, both in collating materials and revising proofs for the present article.

dual cases, therefore, present many diversities, in accordance with the different ways and degrees in which the two diseases are combined. It may happen that they are associated from the first; or one may supervene during the progress of the other, in this way modifying its course, and not uncommonly rendering the diagnosis more or less obscure and difficult. Obviously the exact conditions present in the chest under such circumstances can only be positively determined by adequate physical examination; and it must be remembered that the pleuritic and pulmonary conditions will each tend to modify the signs produced by the other. No general rules can be laid down as to prognosis or treatment, but every case must be regarded on its own merits, in accordance with the principles laid down in the articles which treat of pneumonia and pleurisy respectively. *See* LUNGS, Inflammation of; and PLEURA, Diseases of.

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PLEUROTHOTONOS (πλευρόθεν, laterally; and τόνος, tension).—A form of tetanic spasm, in which the body is bent towards one side. *See* TETANUS.

PLOMBIÈRES, in France.—Thermal waters, with some soda, silicate, and arsenic. *See* MINERAL WATERS.

PNEUMATOCELE (πνεύμων, the lung; and κήλη, a tumour).—Hernia of the lung. *See* LUNGS, Malpositions of.

PNEUMOGASTRIC NERVE, Diseases of.—SYNON.: Fr. *Maladies du Nerf Pneumogastrique*; Ger. *Krankheiten des Vagus.*—Of all the cranial nerves, the pneumogastric has the most extensive distribution, supplying the pharynx, larynx, lungs, heart, œsophagus, and stomach, and even, in part, the intestines and the spleen. In some of the so-called functional diseases of the organs which it supplies its action is conspicuously deranged. The symptoms of its disease are thus very extensive, and it will be well first to describe them generally, and afterwards to consider in detail those which merit separate description.

Some of the functions of the vagus depend upon fibres of the spinal accessory which join it, but it is convenient to consider these in this article.

The pneumogastric, it will be remembered, arises from the side of the medulla, between the glosso-pharyngeal above, and the spinal accessory below, and to the outer side of the hypoglossal. The fibres of origin come from a tract of grey matter which is continuous below with the nucleus of the spinal accessory, and above lies (in the calamus scriptorius) between the hypoglossal and internal auditory nuclei, while to the outer side of its upper extremity, and more deeply seated, is the nucleus of the glosso-pharyngeal. The trunk of the nerve, after receiving fibres from the spinal accessory, and giving off some small branches (of which the most important is one to the external ear), passes down the neck, behind, and in the same sheath with, the carotid artery; enters the thorax on the right side, over the subclavian artery, and, on the left, between the subclavian and the carotid; passes through the thorax beside the œsophagus; and ends in branches to the stomach, spleen, and intestines. The most important branches are the pharyngeal, which, with the glosso-pharyngeal, form the plexus of the same name; the superior laryngeal; the recurrent laryngeal, which passes back, the left around the arch of the aorta, the right around the subclavian artery; branches to the œsophagus; pulmonary branches which, by means of the pulmonary plexus, supply the lung; and branches which form the cardiac plexus for the heart.

ÆTIOLOGY.—The deep position of the pneumogastric and its branches preserves it from some forms of damage, although its extensive course renders it liable to suffer from many causes. The nucleus in the medulla may be damaged by local softening, hæmorrhage, or slow degeneration; but in all these cases other adjacent nuclei suffer (*see* LABIO-GLOSSO-LARYNGEAL PARALYSIS). The nerve, at its origin from the medulla, may be compressed by thickening of the meninges, growths from the meninges or bones, or aneurysm of the vertebral artery. Affections of the nerve due to syphilis are almost always the result of meningeal disease in this situation. Other adjacent nerves commonly suffer at the same time. The trunk of the nerve is sometimes, but rarely, implicated in punctured or gunshot wounds; incised and lacerated wounds damaging it are usually immediately fatal from lesion of the large blood-vessels to which it is contiguous. In surgical operations the trunk and branches of the nerve are occasionally injured. The trunk has been tied in ligature of the carotid, and divided in the removal of deep-seated tumours. In such operations in the lower part of the neck it is often difficult also to avoid injury to the recurrent laryngeal. In excision of an enlarged thyroid both recurrent laryngeals have been repeatedly excised, from the time of Galen down to the present. Sarcomatous and other tumours, and enlarged glands, may compress or involve the nerve in almost any part of its course; and interference with its function especially occurs from such disease in regions limited by rigid structures, as in the upper part of the neck, near the skull, and in the upper part of the thorax. Aneurysms may compress the nerve or its branches; and the recurrent

laryngeals suffer from this cause with especial frequency, because they pass round large blood-vessels. The left suffers much more frequently than the right, because the arch of the aorta is more frequently affected by aneurysm than the subclavian. An enlarged thyroid may compress the recurrent laryngeal nerves, and symptoms due to such compression may vary with the varying size of the tumour. The nerve is, in rare cases, the seat of neuromata. Neuritis of the trunk of the nerve, due to cold, is supposed to be an occasional cause of symptoms, but such cases are extremely rare. It is probably sometimes involved in very severe and grave cases of multiple neuritis, including that due to diphtheria and to beriberi.

Symptoms.—It must be remembered that the vagus nerve, besides containing motor fibres for the pharynx and larynx, is the chief afferent nerve for the respiratory centre. It contains accelerating and inhibitory fibres for this centre, but the former preponderate, so that experimental division of the nerve in an animal renders the respirations less frequent, but deeper, while stimulation of the divided (central) end quickens the respiration, and may even arrest it in tetanic standstill. The inhibitory fibres are contained chiefly in the superior laryngeal nerve, and their stimulation arrests the respiration in muscular relaxation. The vagus is the inhibitory nerve of the heart; slight stimulation increasing the diastolic periods, and stronger stimulation arresting the action of that organ. On division of the nerve the cardiac contractions are accelerated. It has been said to contain trophic fibres for the heart and lungs. The pneumogastric is an afferent nerve for the vaso-motor centre, the action of which is lowered by its stimulation, so that the arteries throughout the body are relaxed. It is the motor and sensory nerve for the œsophagus; the sensory nerve for the stomach; and partly also the motor nerve for the stomach and intestines.

Symptoms due to paralysis of the vagus are more frequently met with than those which result from its irritation. Occasionally both are combined. Laryngeal spasm and vomiting are the irritative symptoms most commonly met with, but occasionally cardiac inhibition occurs. Czermak, for instance, was able to arrest his heart for a few beats at will, by pressing a small tumour of the neck against his pneumogastric. Concato had a patient in whom a similar inhibition could be caused by pressure on the right nerve. The increased frequency of pulse which corresponds to paralysis of the nerve has been several times noted, and has occasionally been associated with diminished frequency of respiration, although the laryngeal paralysis, also resulting, has often obscured the effect on the respiratory movements. Roux tied the trunk of the vagus with the left carotid; instantly respiration was arrested, but the pulse was also retarded. The ligature was immediately relaxed, but the patient died in half an hour. Robert also tied the nerve with the carotid; the patient, who was conscious, immediately called out, 'I am suffocated!' and his voice became hoarse. He recovered, but the hoarseness continued for six months. A good example of interference with the functions of the vagus has been recorded by Guttmann. A lad, after diphtheria, presented paralysis of the palate and of one sternomastoid. His respiration quickly became reduced to twelve per minute, and very laboured, while his pulse rose to 120, and he died in a few hours. In many other cases a similar change in the pulse and respiration has been noted, and even a pulse-rate of 160–200. In the face of these observations, and of experiments on animals, it is not easy to understand a fact, said to have been observed by Billroth, who excised half an inch of one pneumogastric, which was implicated in a tumour, without any resulting symptoms.

The important central relations of the vagus, above alluded to, cause its derangement to form part of many so-called functional disorders of the central nervous system. Its nucleus forms part of, or is connected with, the respiratory centre, which is conspicuously disturbed in hydrophobia and some other diseases. The phenomena of 'Cheyne-Stokes breathing,' or 'respiration of ascending and descending rhythm,' are probably the result of lowered action of the respiratory or pneumogastric centre (*see* Respiration, Disorders of). This symptom is met with in cerebral hæmorrhage, uræmia, meningitis, and in some cardiac diseases. The central connexions of the vagus, in the hemispheres, extend to, or are connected with, those parts which are concerned in emotion, and it is probably through the agency of this nerve that the heart's action is affected in excitement and fear. In many epileptic fits the central representations of the nerve are the parts through which the consciousness is first affected, and hence the so-called 'epigastric aura,' which may seem to ascend to the throat.

A similar disturbance is in all probability the cause of the globus hystericus and of the laryngeal spasm, which are conspicuous in some epileptic and hysteroid seizures. The nerve is closely connected with the centre or nerves for equilibration, so that severe vertigo, on whatever dependent, is often followed by vomiting. The pneumogastric nucleus is contiguous to the internal auditory nucleus, and part of the auditory nerve, that which comes from the semicircular canals (the space-nerve of Cyon), is known to be concerned in equilibration. In the vertigo which results from disease of this nerve, or of the canals (labyrinthine or auditory vertigo),

vomiting is very common, and the nausea and retching of sea-sickness are probably due to the deranged action of the semicircular canals, in consequence of the motion of the endo-lymph disturbing their nerve-endings, which in turn affect the pneumogastric centre. It is possible that the connexion of the vagus with the equilibrial nerves is by means of the cerebellum, disease of which so constantly causes vomiting, although this connexion has not yet been traced. Conversely, gastric disturbance of the vagus is often accompanied by vertigo, especially when combined with pre-existing imperfect action of the auditory nerve.

1. **Pharyngeal Branches.** — The branches of the pneumogastric which enter the pharyngeal plexus supply the constrictors of the pharynx and the soft palate. Some have asserted that all the pharyngeal branches are derived from the spinal accessory. The branches to the soft palate are derived from the spinal accessory. When one vocal cord is paralysed from disease of the roots of the spinal accessory, the levator palati on the same side is, as a rule, also paralysed, and very often there is palsy of that side of the tongue from damage to the adjacent roots of the hypoglossal nerve. *See* Palate, Paralysis of.

(1) *Paralysis.* — Ætiology. — The most common cause of paralysis of the pharynx is disease of the origin of the nerve in the medulla; such disease commonly also involves adjacent nuclei (*see* Labio-glosso-laryngeal Paralysis). Paralysis may, however, result from meningeal disease outside the medulla, from disease of the bones of the base of the skull, but scarcely ever from disease outside the skull. It occasionally forms part of diphtheritic paralysis.

Symptoms.—The chief symptom is difficulty in swallowing. Food lodges in the pharynx about the epiglottis, and small particles and liquids may enter the larynx. If the paralysis is limited to the superior constrictor, liquids may, it is said, be forced up into the nose by the contraction of the middle constrictor; but it is doubtful whether this occurs unless the palate also is paralysed. The affection of one nerve causes only slight trouble in deglutition, no doubt because of the circular arrangement of the muscular fibres.

Diagnosis. — The only conditions with which paralysis of the pharynx can be confounded are spasm and organic disease. The writer once saw an elderly man with distinct pharyngeal paralysis, who had been sent to an eminent surgeon because the difficulty in swallowing was supposed to indicate cancer of the throat. A careful examination is usually sufficient for the distinction.

(2) *Spasm.*—Spasm of the pharynx may be recognised by its paroxysmal character, and is almost always part of 'functional' nervous disease. It forms part of the spasm of hydrophobia; and occurs in hysteria, and in some other allied states. Individuals are sometimes met with who are unable to take food except when alone, so great is the amount of pharyngeal spasm which results from the emotion induced by the presence of other people. Other emotional states may have a like effect; in fear and intense grief swallowing may be impossible, partly from this cause.

2. **Laryngeal Branches.**—It will be remembered that, of the two laryngeal nerves, the superior is the sensory nerve for the larynx, and also supplies motor power to the crico-thyroid muscle, which is the tensor of the cords; while the recurrent laryngeal is purely motor, and supplies the other muscles. The motor fibres of both are derived from the spinal accessory. Of the muscles, the most important in regard to paralysis are the chief abductor, the posterior crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage backwards, and so moves the processus vocalis outwards); the chief adductor, the lateral crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage outwards, and thus the processus vocalis inwards); and the arytænoideus (which approximates the two arytenoid cartilages). Other muscles, acting at the same time, increase the power of closure.

(1) *Paralysis.*—Only paralysis of the abductors and adductors need be discussed in this article. That of the tensors and laxors of the vocal cords, although very important among laryngeal diseases, is always the result of local conditions, not of lesions of the pneumogastric nerve.

Ætiology.—Almost all diseases of the nerve-trunk affect the fibres to the larynx, the only exception being the diseases of the trunk below the origin of the recurrent laryngeal. Syphilitic and other intracranial disease, injuries, and pressure by tumours, all have this consequence; and the motor paralysis is, necessarily, almost as complete in disease of the recurrent laryngeal as in that of any part of the trunk of the pneumogastric. In multiple neuritis, especially that due to diphtheria and toxic influences other than alcohol, the larynx is also sometimes paralysed. Disease affecting the fibres of origin of the spinal accessory at the medulla, or its trunk in the neck, or the recurrent nerve, usually causes paralysis on one side only, but unilateral palsy is rare from general causes, such as those that give rise to polyneuritis. Disease of the nucleus of the nerve is usually bilateral. Another occasional cause of bilateral paralysis is the implication of both recurrents in growths in the upper part of the thorax.

Symptoms.—In complete *unilateral* paralysis the affected vocal cord is usually in

half-abduction, in the position assumed after death. Although there is loss of all movement, that of adduction is the obtrusive defect. In phonation, the unaffected cord moves up to or beyond the middle line, while the paralysed cord remains motionless; and the movements outwards in inspiration and inwards in expiration, are performed only by the healthy cord. The voice, under these circumstances, may be hoarse, or it may be little altered, the healthy cord being moved beyond the middle line into sufficient proximity to the other to permit phonation. Complete approximation, such as is necessary for a cough, is impossible; and in the attempt to cough the patient only succeeds in driving air quickly through the open glottis, and no sudden explosive cough is possible. Sometimes, in complete unilateral paralysis, the affected cord is not in semi-abduction, but is nearly up to the middle line. It is in the position for phonation, and so there is no defective approximation in uttering vowel-sounds; but when phonation is over, and especially during inspiration, the healthy cord is abducted, while the paralysed cord remains motionless. Thus the loss of abduction is the conspicuous defect. On what the difference in the position of the paralysed cord depends, whether it is in abduction or in adduction, is not quite certain. The position of adduction is seen especially in paralysis of the recurrent nerve. One explanation is that the position of abduction is the early state, and that after a time, in some cases, adduction results from unopposed muscular contracture (Riegel), but it is probable that the key to the problem lies in the greater power of the adductors, which causes adduction to result from electrical stimulation of the recurrent laryngeal, and a defect, equally distributed, will have far more relative influence on the more feeble abductors. When the cord is in the position of adduction, the voice is high-pitched. At rest there is no dyspnœa, but on exertion the unabducted cord interferes with the entrance of sufficient air, and respiration becomes stridulous and short; but there is rarely, if ever, sufficient dyspnœa to render tracheotomy necessary.

Bilateral paralysis is much less common. It may be due to central disease; to diphtheria; to multiple neuritis; to pressure on both recurrent laryngeal nerves from tumours in the upper part of the thorax; or to the injury of these nerves in the excision of enlarged thyroid. Two remarkable cases have been recorded (Baümler, Johnson), in which pressure on one recurrent laryngeal and vagus has caused paralysis of both vocal cords, in one case equally, in the other less on the side opposite to the tumour than on the same side. Sir George Johnson suggests that the mechanism is probably an inhibition of the central nucleus on both sides, by the pressure of the afferent fibres in the vagus. In bilateral paralysis the same difference in the position of the cords is met with as in unilateral paralysis. Sometimes they are apart, in half-abduction, and sometimes approximated in adduction. In each case they are motionless. In the first instance the absence of the adduction for phonation is more conspicuous than the want of respiratory movement, and leads to the condition being designated *paralysis of the adductors*; in the latter the absence of the normal abduction on inspiration attracts chief attention, and there is said to be *paralysis of the abductors*. It is probable that the explanation above given applies to these cases also. The difference between the two in their symptoms is very great. When the vocal cords are in abduction, phonation is almost, or quite, impossible, and there is no closure of the glottis in cough. There may be no dyspnœa except during very active exercise. When, however, the cords are near the middle line, the patient's condition is very different. He is able to speak, but only in a high, stridulous voice. The most urgent symptoms arise from the absence of the normal respiratory movements. Instead of being abducted in inspiration, the pressure of the air brings the cords closer together, while the current, in expiration, separates them. This inspiratory approximation of the cords constitutes a source of the gravest danger. When the patient is at rest enough air may enter to prevent dyspnœa, but exertion brings on stridor and intense difficulty of breathing. The least swelling of the cords occludes the glottis entirely. This condition is one of great rarity, and is most commonly due to central disease, especially of degenerative nature.

Slight impairment of adduction of the cords is a very common and much less grave affection, met with in general weakness, hysteria, and local inflammatory diseases. It has been termed 'phonic paralysis,' because in the slight effort of speaking the cords are not approximated, while in the stronger effort of the cough they are brought together perfectly. It does not result from nerve-lesions.

Anæsthesia of the larynx may result from disease of the superior laryngeal nerve, but is extremely rare from this cause. Lessened sensibility, bilateral in character, is not uncommon in central disease of the medulla.

(2) *Spasm.*—The common form of spasm of the laryngeal muscles is that of the adductors. The muscles which close the glottis are far more powerful than those which open it, hence any irritation of the nerves—direct, central, or reflex—causes closure. For this closure, since it plays an important part in many physiological processes, a central mechanism is provided, which is readily excited by various means.

In cough, for instance, it may be stimulated, not only from the special afferent nerves of the throat, larynx, and lungs, but also by those of the stomach, and even, it is believed, by the branch of the vagus which goes to the external auditory meatus. Spasmodic cough may result from the simple irritability of the centre, as in hysteria; and a peculiar barking cough is occasionally the result of masturbation in boys. In whooping cough, again, the glottis, after being closed, is imperfectly relaxed, so that a sound accompanies the next inspiration. Simple laryngeal spasm, without implication of the expiratory muscles (laryngismus stridulus), occurs in children, in whom, in consequence of the constitutional condition known as rickets, the central nervous system is in a state of undue irritability. In this the vaso-motor centre seems to participate; a child, on some exciting cause, as a start, a reflex impression, or on none, suddenly turns pale, is unable to get its breath for a few seconds, and then, the spasm relaxing, air is drawn through the slowly opening glottis with a crowing noise. Quite similar attacks may occur in adults. They may be accompanied by distinct convulsive action elsewhere. In the paroxysms of epilepsy a similar combination is seen; the epileptic cry is the result of laryngeal spasm. Hydrophobia also is attended with a paroxysmal closure of the glottis.

Since the closure of the glottis is the physiological effect of irritation of the afferent laryngeal nerves, it is not surprising that spasm accompanies a large number of laryngeal diseases, varying in its prominence according to the irritative nature of the disease, and the irritability of the reflex mechanism; and, since the latter is most intense in children, we have in them a condition in which the slightest local catarrh gives rise to spasm. The attacks tend to occur especially at night, when the reflex centres, released by sleep from the control of the higher, are in their most active state. Spasm may occur, not merely from irritation of the laryngeal nerve, but from that of the vagus below, or by compression by tumour, the afferent nerves from the lungs being sufficient to generate it. Reflex spasm is always bilateral in character. Direct spasm by irritation of the recurrent laryngeal usually involves only one vocal cord; but in a few cases spasm so excited has been bilateral. This result can only be explained either by assuming the irritation of some afferent fibres, or by ascribing it to the spasm of the arytænoideus, which is a bilateral muscle (Krishaber).

A very rare condition of 'functional spasm' has been described, in which spasm is excited by attempts to speak. It has been thought to be similar in its nature to writer's cramp.

3. **Pulmonary Branches.**—The effect of disturbance of the pneumogastric on the respiratory movements, and the reflex effect of disturbances of the afferent pulmonary branches, have been already described. The muscular fibres of the bronchi are innervated by the nerve, and their paroxysmal contraction in asthma is thought to be produced through its agency. It has been asserted that the plain muscular fibres, said to exist throughout the lung-tissue, are supplied by it (Gerlach), and their contraction has been assumed to explain a peculiar form of emphysema, which has been observed in compression of the pneumogastric (Tuczek); but, since deep breathing of a costo-superior type was observed, it is possible that the effect is the result of the energetic respiration from the disturbance of the centre. The pneumogastric is commonly believed to contain vaso-motor fibres for the vessels of the lungs, but Brown-Séquard and Franck have separately shown that these fibres are contained, not in the vagus, but in the sympathetic. Vascular lesions of the lungs have, however, been observed after section of the vagus. Michaelson noted rapid congestion and hæmorrhage, and the congestion is sometimes noted after lesions of the pons. In a case of hæmorrhage into the pons, fatal in two hours, the writer found intense congestion with extravasation into the left lung, and hæmorrhages in the left extremity of the stomach.

After section of the vagus, animals die from chronic pneumonia, and hence the vagus has been supposed to be a trophic nerve for the lungs. But the changes have been accounted for by the entrance into the bronchi of food from the pharynx, in consequence of the obstructive paralysis of the œsophagus, and the paralysis of the larynx (Traube, Steiner). All admit that this is one cause of the pulmonary affection, but differ as to its adequacy in all cases. The question is still undecided.

4. **Cardiac Branches.**—The inhibitory effect of irritation, and the acceleration of the heart's action which results from lessened action of the vagus, have been before alluded to. The increased frequency has been several times observed in cases of local disease of the vagus in the thorax, compression by mediastinal tumours, &c. In a case of phthisis, for instance, in which the pulse was at first occasionally, and afterwards constantly, frequent (130–148), Meixner found the left vagus enclosed in a mass of enlarged glands in the upper opening of the thorax. The vagus is also the afferent nerve from the heart, and although we are normally unconscious of the cardiac action, some of the disordered sensations of disease are apparently produced through its agency. The subject of angina pectoris, and its relation to the vagus, is discussed in a separate article, but it may be here noted that in some anginal attacks the

heart's action is, for a time, arrested or retarded, and that in a few cases these symptoms have been found associated with organic disease of the cardiac plexus. Thus in a case in which, during paroxysms of intense anginal anguish, the heart's action was arrested for four or six pulsations, Heine found a tumour involving the cardiac plexus. In a case recorded by Blandin, anginal attacks were associated with a small tumour of the vagus. Further, there are afferent fibres from the heart inhibiting the action of the vaso-motor centre, and these are probably stimulated in some anginal seizures. *See* Angina Pectoris.

After disease or injury of the vagus, the heart has been found in a state of fatty degeneration, and hence it has been thought that the vagus contains trophic fibres for the cardiac substance.

5. **Branches to the Alimentary Canal.**—The branches to the œsophagus are rarely diseased except in cases of affection of the nerve-trunk or of the centre. In very rare cases such disease has caused difficulty in swallowing, simulating stricture. Spasm of the œsophagus is more frequent. The vagus is the sensory, and in part the motor nerve for the stomach. Its fibres are very sensitive to any local irritation, and not rarely the seat of spontaneous neuralgia. Hunger is generally believed to be a pneumogastric sensation, and complete loss of the sensations of hunger and thirst was noted in a case of softening of the root of the vagus from an aneurysm of the vertebral artery (Johnson). Appetite, however, is not always lost in animals when the pneumogastrics have been divided (Reid). In some cases of disease of the nerve, excessive appetite has been noted. This symptom, for instance, was present in one case, in conjunction with dyspnœa, noisy breathing, and vomiting of unaltered food; *post mortem*, both pneumogastrics were found atrophied (Swan). In another case of insatiable appetite, small neuromata were found on the nerve. It is possible that the polyphagia may be in part the result of the defective digestion of food.

The pneumogastric is also in part the motor nerve of the stomach; after its section the contractions of the organ are lessened, although not altogether arrested. Vomiting is probably produced through its agency, by varied reflex and central irritation. In the latter case (as in meningitis) the vomiting is sometimes extremely rapid. The writer has known paroxysmal vomiting to result from the intermitting pressure of a tumour on the vagus; and Boinet, having exposed the vagus in an operation in the neck, noted that whenever he touched the nerve the patient vomited.

The vagus accelerates the contraction of the intestines, but no intestinal symptoms have been observed to result from its disease.

General Diagnosis.—The chief symptoms on which the diagnosis of disease of the vagus, in any given case, would rest, are the laryngeal paralysis; retarded respiration; accelerated or retarded heart; and vomiting. The diagnosis of the seat of the disease rests upon the range of the symptoms, and the associated morbid processes. Disease of the trunk of the vagus is much less common than disease of its branches or roots. Paralysis of one vocal cord, for instance, is almost always the result of pressure, either on the recurrent laryngeal, or on the roots of the spinal accessory at the medulla. Bilateral symptoms are usually due to central disease, or else (if slight) are of merely local origin. In most cases of pressure on the trunk and branches of the vagus the cause of the symptoms is distinct, the only exception being deep-seated tumours in the thorax.

Prognosis.—The prognosis is that of the cause of the disease, and is sufficiently discussed in other articles.

Treatment.—Little can be said on the general treatment of the diseases of the pneumogastric, since it depends on the different conditions to which the symptoms are due, and which are described elsewhere. Central disease, and causes of pressure on the nerve, are, as a rule, beyond the range of treatment. Whenever there is reason to suspect pressure on the nerve-roots (from the combination of paralysis of the tongue, palate, and one vocal cord), iodide of potassium should be given, since this condition is more frequently due to syphilis than to any other cause. In laryngeal paralysis the local application of electricity is sometimes useful, but more so in the weakness which depends on local causes than in that which is due to nerve-lesions. Injections of strychnine are also sometimes useful, even when its administration by the mouth is without effect. In central paralysis the treatment will depend on the indication given by the mode of onset regarding the nature of the lesion, whether softening or degeneration. In all spasmodic affections, sedative inhalations, especially chloroform, are useful; and of especial service is the diminution of the afferent impressions from the larynx such as may be produced by the application of cocaine. Bromides and morphine alone lessen, in effective degree, the irritability of the nerve-centre.

W. R. Gowers.

PNEUMOGRAPH (πνεύμων, the lungs; and γράφω, I write).—An instrument for recording the movements of respiration. *See* Physical Examination.

PNEUMONIA (πνεύμων, the lungs).—Inflammation of the substance of the lungs. *See* Lungs, Inflammation of.

PNEUMO-PERICARDIUM (πνεῦμα, air; and περικάρδιον, the pericardium).—A collection of gas in the pericardium. *See* PERICARDIUM, Diseases of.

PNEUMOTHORAX (πνεῦμα, air; and θώραξ, the chest).—A collection of gas in the cavity of the pleura. *See* PLEURA, Diseases of; and LUNGS, Perforation of.

POCK.—A popular term for pustule, as though a pocket or pouch in the skin filled with pus. From the plural of pock is derived *pox*; hence, *small-pox*, *chicken-pox*, the *great pox* or *venereal pox*, and so forth.

PODAGRA (πούς, the foot; and ἄγρα, a seizure).—A common synonym for gout, as it usually attacks the foot. *See* GOUT.

PODALGIA (πούς, the foot; and ἄλγος, pain).—A name for pain in the foot, due to any cause, such as gout, rheumatism, &c.

POINTS DOULOUREUX (Fr.)—Tender points in connexion with the affected nerves in neuralgia. *See* NEURALGIA.

POISONOUS ANIMALS. — *See* VENOM AND ITS EFFECTS; VENOMOUS ANIMALS.

POISONOUS FOOD.—Under certain conditions, various articles of diet may become possessed of poisonous properties. This may arise from a variety of causes, in addition to the introduction of known and specific poisons. Articles of food may become more or less poisonous from the following causes :—

1. *Flesh* may contain some poisonous substance administered as a drug or eaten as a food.

2. Poisonous substances may be derived from the *vessels* in which the food has been kept, for example, tinned provisions may become contaminated with tin derived from the vessel or solder; beer and cider which have stood in leaden pipes may become contaminated with lead.

3. Poisonous substances may be added by way of adulteration, as in the case of the colouring of preserved peas and olives with copper salts.

4. Certain *kinds of foods* may develop poisons even in the fresh state, for example, meat and some kinds of fish, as mussels, salmon, and sardines.

5. Food may become poisonous from the development of poisons (such as ptomaines or alkaloidal poisons, and albumoses or proteid poisons) as the result of fermentative or putrefactive changes in the albuminous constituents, produced by the agency of ferments.

6. Food may be poisonous from the presence of the germs or spores of certain specific or parasitic diseases, namely, tuberculosis, trichinosis, actinomycosis, hydatid disease, and anthrax disease may be conveyed to man in this way, or the germs or spores of diseases may obtain access to food from exposure to sewer air.

7. The flesh of animals may be poisonous from the animals having fed on noxious or poisonous plants; and under this head may be classed poisonous honey which bees have gathered from poisonous plants.

8. Food, and especially milk, may become infected with pathogenic micro-organisms or poisons of human origin, for example, enteric fever, diphtheria, and scarlet fever.

9. Food may contain various parasites; for description of which *see* ENTOZOA.

Sound and unsound meat.—The obvious characteristics of good sound fresh meat are that its colour is red; it is marbled in appearance; firm and elastic to the touch; possessing a slight but not unpleasant odour, which is especially detected when a clean knife is thrust into the meat and withdrawn; and when exposed to the air for a day or two, it should neither become dry on the surface, nor wet, nor sodden. Sound meat is slightly acid to litmus paper ; unsound meat may be neutral or alkaline. With commencing putrefaction the colour of the meat becomes pale, and the smell disagreeable, and later the meat softens in parts and turns green.

Poisonous Meat. — Cases of meat poisoning have occurred from the eating of the following kinds of meat: boiled ham, baked pork, boiled and salted pork, sausages, tinned pigs' tongues, roast beef, brawn, veal pie, pork pie, beef pie, American ham, tinned ox-tongue, chicken broth.

The symptoms exhibited are those of more or less severe gastro-intestinal disturbance, with those indicating various degrees of disturbance of the nervous system. The first symptoms of illness usually set in somewhat suddenly, at a varying period after the eating of the poisonous food; they consist of nausea, vomiting, abdominal pain, and diarrhœa (the stools being generally of a very offensive character), accompanied with a sense of faintness, muscular weakness, and feeling of prostration, which is sometimes very severe. Rigors may or may not occur. These symptoms are generally followed by fever and headache (which is often intense), and great thirst.

If the illness progresses, however, other nervous disturbances may be observed, such as cramps, muscular twitchings, disturbances of vision, dilatation of the pupils, drowsiness, and occasional coma. The appearances observed in the organs of the body after death occurs are inflammatory, hæmorrhagic, or destructive changes in the stomach and intestines; engorgement of the lung-tissues with blood; and inflammatory or destructive changes in the liver and kidneys. These phenomena must be regarded not merely as

the result of local irritation, but of a general disease resembling in some of its effects the ordinary specific fevers.

This point has been insisted on by Sir George Buchanan in one of his Reports to the Local Government Board, in which he says 'that the phenomena which were spoken of as food poisoning are claiming on ever-growing evidence to be regarded as true infective diseases, as much so as was scarlet fever or tuberculosis; that they have not been generally admitted into this rank arises, first, from the circumstance that some of them have seemed to be wanting in the incubation period, and, secondly, because they are rarely recognised as being transmissible from person to person; while in the Middlesborough epidemic of 1888 we found suggestion of disease bacteria operating alternately through the atmosphere and through infection of food material by them.'

The Middlesborough epidemic that prevailed during the early part of 1888, and which resulted in 490 deaths during the year, in a population of 98,000, was an epidemic of pleuro-pneumonia due, at all events in part, to the consumption of American bacon, made by soaking in water, and then only slightly drying, salted pork imported from America. In this bacon there was discovered a bacillus which was capable of producing a specific general fever, the special characteristic of which was a pleuro-pneumonia.

From investigations of the cases of food poisoning that have occurred with the various kinds of meat mentioned above, the following inferences may be drawn, viz.:—

1. In food rendered poisonous by keeping we find one or both of two things, namely, a living microscopic organism, and an organic chemical poison (ptomaïne, albumose, or toxin).

2. The material that is in all probability immediately operative in the production of morbid phenomena is the chemical poison, which is probably a product of the action of the micro-organism on the albuminous constituents of the food.

3. The micro-organism, provided its surroundings are favourable to its growth and activity, may produce its own special chemical poison from the material which affords it nourishment either outside the body or within it.

4. Both the micro-organism that produces the chemical poison in an infected food, and the chemical poison itself, may be evanescent; as on the one hand the micro-organism may be killed by its own products, and on the other the chemical poison may undergo destructive changes, so that the infected food, poisonous when eaten at one time, may fail to be poisonous when eaten at a later period.

5. In many cases of food poisoning the incubation period has been traced; in others it has been less obvious, and in some there is practically none. The symptoms which arise after the incubation period are probably due to the operation within the body of the micro-organism, and the symptoms produced without an incubation period (*i.e.* from half an hour to a few hours after taking the food) may probably be due to the operation of the organic chemical poison previously produced in the food. This inference is a fair one, since the micro-organism would require time, as in the other specific infections, for its growth and cultivation in the body, and for the formation of its poisonous chemical product; whereas the chemical poison previously produced in the article of food would operate more speedily, the rapidity of its operation being in proportion to its toxic nature, the amount taken, and the individual peculiarities of the recipient.

6. Of some of the animal foods mentioned as producing poisonous effects, Dr. Ballard has tabulated thirteen instances, in which the food was, or consisted largely of—

Pig's meat of one kind or another	in	9	instances
Butcher's meat (kind not stated)	„	2	„
Veal	„	1	instance
Beef	„	1	„
Total . .		13	

This is probably a fair representation of the relative frequency with which swine's flesh gives rise to specific diseases of the kinds referred to, as compared with animal food from other sources. In connexion with these forms of food poisoning, the poisonous effect is not necessarily always due to ptomaïnes or albumoses or toxins produced by a putrefactive decomposition of the article of food consumed. In some cases the symptoms and death are due to a true infection, extremely virulent bacilli having been found in articles of food, and also in the viscera of individuals who have died from eating such articles.

Some of these bacilli, as Dr. Klein has shown in the Portsmouth pie-poisoning case, may not be pathogenic on inoculation, though when taken by the mouth or in cultures they may produce a chemical poison, which, received into the alimentary canal, produces illness and death, if in sufficient quantity.

The toxicogenic powers of these bacteria are largely influenced by the conditions under which they develop. The most important of these conditions are—

(*a*) The nature of the food infecting the body; (*b*) the temperature; (*c*) the amount of oxygen supplied; (*d*) the time which elapses between the infection and the consumption of the food.

The poisonous properties of some kinds of

meats and fish are due in some instances to the fact that the germs which they contain grow practically without any air-supply (as was in all probability the case in connexion with the tinned-salmon poisoning case investigated in 1891 by the writer, and the tinned-sardine poisoning case investigated in 1892 by Dr. Stevenson). In such cases, in all probability, the contents of the tin were not sterilised, and, after sealing, the germs within the tin continued to grow anaërobically, and elaborated a chemical poison.

On the other hand, several cases have been recorded in which canned meats were not poisonous when first opened, but soon became so on exposure of their contents to the air. In such cases, the meat in all probability becomes first infected after the opening of the can.

With regard to the nature of the chemical poisons formed in articles of food as a result of infection with pathogenic bacteria, three classes may be described—

1. The ptomaïnes or putrefactive animal alkaloids. *See* Ptomaïnes.

2. The albumoses or poisonous proteids, produced by bacterial agency. *See* Albumoses.

3. The toxins or poisons of uncertain composition, also doubtless produced by bacterial agency.

Preventive and Curative Measures.—Good cooking, namely, exposure to a sufficiently high temperature for a sufficiently long time, is undoubtedly the best treatment—short of absolute destruction—of unsound and diseased meat. Smoking meat is less effective than cooking; salting, as a rule, is more effective than smoking, but there is evidence to show that smoking may merely hold the life of micro-organisms in suspense; for instance, in the conversion of American salted pork into American hams, a specific germ (a bacillus) has been known to retain its harmful properties. The best precaution of all is cleanliness. Factories where articles of meat are prepared and tinned should be well ventilated and lighted, and clean; and the incursions of ground air, sewer air, or putrid emanations of any kind should be rigidly prevented. Kitchens and pantries should also be similarly cared for.

With regard to the curative measures for the results of eating poisonous food, these must be guided by general principles. The gastro-intestinal and nervous symptoms are to be treated, and the powers of the patient sustained until the poisonous matter is removed by excretion.

In many cases of meat and fish poisoning the following prescription for adults is a useful one, administered every three or four hours until the effects of the poison have passed away: Solution of the perchloride of mercury ♏ xx; iodide of potassium gr. v; chloral hydrate gr. v; carbolic acid gr. j; aromatic spirit of ammonia ♏ xx; chloroform water ad ℥j; one dose.

In addition to the different forms of meat already described as producing poisonous symptoms, the following articles of food have also been known to occasionally produce toxic effects.

(*a*) *Tinned articles of food.*—Salmon, sardines, anchovies, ox tongue, pigs' tongues, meat, cherries, apples, and peas.

Tinned cherries and apples have been known to produce poisonous effects from soluble tin salts contained in them, produced in all probability by the malic acid present in the juice exerting a galvanic action upon the solder of the tins, carrying some of the tin into solution as a malate of tin (*see* four cases of tinned-cherry poisoning investigated by the writer: *Brit. Med. Journ.*, April 12, 1890). Tinned and bottled peas sometimes contain copper salts which have been added for the purpose of colouring them.

(*b*) *Fish.*—Cases of poisoning by fish, crustacea, and the various shell-fish of our islands are not infrequently met with. Generally it is the ingestion of crabs, lobsters, and mussels which produces such results. Symptoms of gastro-intestinal disturbance and nettle-rash are usual, but occasionally fatal results ensue from the use of mussels. In the case of poisonous mussels, Brieger has shown the toxic effects to be due to a ptomaïne which he has named mytilotoxine, and which is doubtless produced within the mussels by bacterial agency, the bacteria most probably gaining access to the mussels through the medium of sewage-polluted water—since it has been found that mussels gathered on shores polluted by sewage are not infrequently poisonous in their effects, and contain the toxic ptomaïne; whereas, if laid for a few months in the open sea, they soon lose their poisonous properties, and cease to contain the toxic ptomaïne.

(*c*) *Milk.*—This important article of diet may produce symptoms of poisoning or disease in many ways: (1) If acid from lactic acid fermentation (due to the presence of the *bacillus acidi lactici*), it is frequently productive of flatulence, sickness, and diarrhœa in children. (2) Milk may contain the germs of typhoid fever, scarlet fever, diphtheria, and cholera. The germs of typhoid fever may gain access to the milk, either in water polluted by typhoid stools having been added to the milk or used to cleanse the milk cans, or by exposure of the milk to sewer air. The germs of scarlet fever may be conveyed into the milk from the hands of a milker suffering from scarlet fever, or from cows suffering from a disease identical with, or closely resembling, human scarlet fever. Diphtheria is possibly conveyed from the cows themselves, and cholera through the medium of contaminated

water. (3) Tubercle may gain access to the milk from the tubercular udders of cows, and if the milk is unboiled it is in this way easy to account for the high mortality of young children from tubercular ulceration of the intestines and tabes mesenterica. (4) Milk may be contaminated from the animal suffering from foot-and-mouth disease (vesicular eczema of the mouth and interdigital spaces of the feet); if there are vesicles on the teats of cows suffering from this disease the virus may get into the milk, and a person consuming that milk may be attacked with fever, vesicular eruption on the throat and lips, and swelling of the lymphatic glands of the neck.

(*d*) *Cheese.*—In cheese that has undergone a peculiar fermentation a poison has been discovered by Vaughan, which is a ptomaïne named tyrotoxicon (diazo-benzene butyrate). This ptomaïne is intensely poisonous, producing nausea, dryness of the mouth and fauces, a sense of constriction in the throat, vomiting, diarrhœa, and great nervous prostration. The symptoms usually pass off after the lapse of a few hours, but may end in death from collapse. Cheese containing this poison is not necessarily altered in appearance or taste. Butter and cream, as well as cheese, have given rise to ptomaïne poisoning.

(*e*) *Vegetables.*—Vegetables may become poisonous either from the development of poisonous matter produced by putrefactive changes, or from the addition of poisons, as in the colouring of peas with copper, or from the growth within them of fungi. For instance, actinomycosis, a disease which occasionally occurs in cattle and man, is now regarded as due to eating raw barley or other cereals upon which the actinomyces fungus has grown. *See also* Ergotism; and Mushrooms, Poisoning by.

(*f*) *Water.*—Drinking-water may produce poisonous effects, either from the presence of specific micro-organisms (generally from pollution of the water with sewage), or from contamination of the water with metallic poisons, such as lead and copper.

Arthur P. Luff.

POISONOUS GASES.—*See* Carbonic Acid, Poisoning by; Carbonic Oxide, Poisoning by; Prussic Acid, Poisoning by; &c.

POISONS.—Synon.: Fr. *Poisons*; Ger. *Gifte.*

Definition.—There is no legal definition of the word *poison*, and the definitions usually proposed are apt to include either too much or too little. Generally, a poison may be defined as a substance having an inherent deleterious property, which renders it capable of destroying life by whatever avenue it is taken into the system. Substances which act only mechanically, such as powdered glass, are not poisons. In popular language, a poison is a substance capable of destroying life when taken in small quantities. A poison, then, may be defined as any substance which, when introduced into the system, or applied externally, injures health or destroys life irrespective of mechanical means or direct thermal changes. *See* Poisonous Food.

Action.—Poisons may exert a twofold action. Their action is either local or remote, or both local and remote. The local action of a poison is usually one of corrosion, inflammation, or an effect on the nerves of sensation or of motion. The remote actions are usually of a specific character, though some writers group the remote effects of poisons under two heads, and speak of the common and specific remote effects of a poison. The local actions of a poison of the corrosive class are usually so well marked, and so easily recognised, that the fact of its administration is obvious. The same may be said, in a lesser degree, of the irritant poisons, especially the mineral irritants; but here the symptoms often so closely simulate those of natural disease, as to render the diagnosis a matter of great difficulty. An accurate acquaintance with the remote specific effects of the various common poisons is indispensable to the medical practitioner. The class of poison which has been administered or taken will thus be suggested to his mind by the symptoms observed, and not infrequently the specific poison will be suspected. In this way the physician may often be at once able to diagnose, from the symptoms alone, the administration of strychnine, henbane, or cantharides. Great care must be taken, however, not to draw a rash conclusion from one symptom; as, for instance, from the tetanic spasms which are so marked a feature in strychnine poisoning.

It is generally, but not universally, held that absorption is necessary in order that a poison should be able to exert its specific effect. Some are of opinion that a poison may destroy life by an action on the nervous system, before absorption has had time to take place. The facts in support of this view are, however, few, and open to doubt.

Modifying Circumstances.—The usual action of poisons may be greatly modified—(1) by the largeness of the dose, and the state of aggregation, admixture, or chemical combination of the poisons themselves; (2) by the part or membrane to which they are applied; and (3) by the condition of the patient. Thus, for example, opium may be a medicament or a poison, according to the dose in which it is given; and a dose of opium which may be beneficial to an adult in certain states of the system, may be fatal to a young child, or to the adult when suffering, for example, from Bright's disease. All barium salts are poisonous, except the sulphate, which is one of the most insoluble of

all mineral substances. The simple cyanides are highly poisonous, and the same may be said of many double cyanides. But the double cyanide of iron and potassium (potassium ferro-cyanide) is almost without action on the system. The part or tissue to which a poison is applied must obviously greatly affect the activity of a poison, owing to the varying rapidity with which absorption takes place through the cutaneous, mucous, serous, and other surfaces of the body. Curare may be swallowed in a considerable dose, without producing any appreciable effect, whilst a small quantity of the same substance introduced into a wound will speedily prove fatal. It has been found that when a poison is slowly absorbed, so that it can be either disposed of in the system or again excreted more rapidly than it is absorbed, no poisonous results ensue; but when absorption occurs so quickly that the poison can neither be excreted nor destroyed in the system as rapidly as it is absorbed, the specific effects of the poison are developed. Curare, for instance, is absorbed by the gastric mucous membrane more slowly than it is excreted through the kidneys. But if the renal arteries be ligatured, the poison accumulates in the blood, and the specific effects of the poison are developed, just as when curare is introduced into a wound.

Idiosyncrasy has much to do with the poisonous or hurtful character of a substance. Thus pork, mutton, certain kinds of fish, notably shell-fish, and fungi (*see* MUSHROOMS, Poisoning by), have, under certain circumstances, and in certain persons, produced all the symptoms of violent irritant poisoning; whilst others, who have partaken of the same food at the same time, have enjoyed perfect immunity. More commonly, all who partake are affected, but with varying degrees of severity. Some persons are said, on good authority, to be capable of taking with impunity such violent poisons as corrosive sublimate or opium, in enormous doses, and this independently of habit, which is known to have such a large influence in modifying the effects of some poisons, notably of the narcotics. A tolerance of poisons is sometimes engendered by disease, so that a poison may from this cause fail to produce its accustomed effect. Thus opium is largely tolerated in tetanus, and in mania from drink; and mercurial compounds may in severe febrile affections fail to produce the usual constitutional effects of the metal. On the other hand, kidney-disease, by impeding elimination, may intensify the ordinary effects of a poison; and the like is observed when opiates are given where there is a tendency to cerebral congestion.

EVIDENCE.—In order to raise a valid inference in the mind of the medical attendant that poison has been administered to a patient, certain facts must be brought under his notice; and without the concurrence of at least two or more of these, the actuality of poisoning cannot be maintained. The sources of evidence in cases of suspected poisoning are the *symptoms*; the *post-mortem appearances*; *chemical analysis* of articles of food or drink, or of the body and the excretions; and *experiments upon animals*. The evidence derived from these sources being compared with the known properties and effects of various poisons in authenticated cases, will enable the physician to form a correct opinion as to the probable administration or not of a poison. The poisons most commonly administered are opium, carbolic acid, arsenic in various forms, phosphorus, oil of vitriol, strychnine, and oxalic acid.

It is rarely that the *symptoms* exhibited during life do not afford some clue to the cause of illness; and most frequently the symptoms are all that the medical attendant has to guide him to a diagnosis of the nature of the case, during the lifetime of the patient. Sometimes, however, persons are found dead as the result of poison, concerning the manner of whose death nothing whatever can be learned; a suspicion of poisoning arising from the circumstances under which the corpse is found. Here the aid of chemical analysis ought invariably to be invoked; and fortunately in these cases the delay involved in making an analysis is of comparatively little moment. The effects may in the case of many persons be either suddenly or slowly manifested; hence we have *acute* and *chronic* poisoning. Cases of chronic poisoning are usually the result of the repeated administration of small doses of lead, copper, mercury, phosphorus, or arsenic. All of these poisons are treated of in separate articles. The general conditions which should excite a suspicion of poisoning are the sudden onset of serious and increasingly alarming symptoms in a person previously in good health, especially if a prominent symptom be epigastric pain; or where there is complete prostration of the vital powers, a cadaverous expression of the countenance, an abundant perspiration, and speedy death. In all such cases the aid of the chemist is required, either to confirm well-founded, or to rebut ill-founded, suspicions.

CLASSIFICATION.—Various attempts have been made to classify poisons rationally. Perhaps the best classification, for the purposes of the medical practitioner, is that which groups poisons according to the more obvious symptoms which they produce. Our knowledge of the more intimate action of many poisons is still too slight to admit of any useful classification according to the manner in which they specifically affect the vital organs.

Poisons may in the manner indicated be classified as: (1) **Corrosives**; (2) **Irritants**;

and (3) **Neurotics.** It is perhaps at present premature to attempt a systematic division of the last class. The class of neurotics embraces poisons so widely different in their action as opium and strychnine.

1. **Corrosive Poisons.**—Enumeration. The action of one of the most typical of these poisons, corrosive sublimate, is fully considered under a special head (*see* Mercury, Poisoning by). The most commonly administered corrosives are the mineral acids—sulphuric, nitric, and hydrochloric; oxalic acid; the alkalis—potash, soda, and ammonia; acid, alkaline, and corrosive salts—such as acid sulphate of potassium, carbonate of potassium, chlorides of zinc, tin, and antimony, and nitrate of silver.

Symptoms.—The mineral acids and the alkalis have no specific effect on the system, their action being at first almost purely local. Some of the other corrosives enumerated may have, besides their local effects, a remote and constitutional action. The symptoms of corrosive poisoning are marked and unmistakable, except when the patient is an infant. Immediately after swallowing the corrosive substance, an acid, caustic, or metallic, burning sensation is felt in the mouth, fauces, gullet, and stomach; and this speedily extends over the whole abdominal region. Vomiting is speedy, or may, rarely, be altogether absent. The vomited matters consist at first of the ordinary contents of the stomach, more or less altered by the action of the poison. In the case of *mineral acids* they are intensely acid, and cause copious effervescence when they fall upon limestone or marble. No relief is afforded by the evacuation of the stomach; and later the vomits may be more or less mingled with altered blood, which may be dark, or even black. Shreddy mucus, casts of the gullet or stomach formed by the shedding of the mucous membrane, and sometimes even the muscular wall of the œsophagus, are rejected. The abdominal pain is not relieved, but greatly aggravated, by pressure. The whole abdomen becomes distended, owing to the gases evolved by the action of the poison; the diaphragm is pressed upon, and intense dyspnœa may result, owing to pressure upon the thoracic viscera. When a mineral acid has been administered, there is little or no bowel action, and the urine may be suppressed; but in poisoning by the *alkalis*, and by the *alkaline carbonates* and *sulphides*, there may be purging. The mouth, tongue, and fauces exhibit the local effects of the corrosive: a yellow coating in the case of nitric acid; white at first, and as if covered with white paint, from sulphuric acid; and whitish or brown and less thickly coated from hydrochloric acid. Yellow or brown stains may be observed on the skin, extending downwards from the angles of the mouth, and caused by the trickling of acid or other corrosive fluid from the mouth. Meantime the symptoms develop rapidly. The pain, thirst, dyspnœa, and dysphagia increase. The patient, at first excited, with rapid bounding pulse, becomes bathed in cold perspiration, the countenance becomes pinched, the pulse more rapid and thready. Enormous eructations of gas take place, but these afford no relief. The patient may become more or less cyanosed; but this will depend upon the amount of dyspnœa. The intellect is usually clear to the last. Signs of collapse come on, and the patient may sink within a period varying from six to twenty-four hours. If recovery does not take place, death usually supervenes within a period of twelve to twenty-four hours. Very frequently, and more especially in poisoning by oil of vitriol, the patient survives the first acute symptoms only to perish months after, should not the aid of the surgeon be invoked and gastrotomy be performed, by slow starvation, due to local injury to, and subsequent stricture of, the œsophagus. The use of bougies in these cases, to keep the gullet patent, seldom affords permanent relief.

When *nitric acid*, or *ammonia*, is the poison taken, the vapours of the acid or of the ammonia may gain access to the air-passages and lungs, provoking inflammation, which is commonly fatal. The dyspnœa and chest-symptoms will be greatly aggravated in these cases, and may overshadow the more usual symptoms due to local action on the digestive canal. In poisoning by the *caustic alkalis* (potash and soda lyes) diarrhœa, with discharge of blood, is more common than the constipation observed in poisoning by the mineral acids. Entire suppression of urine, or anuria, is the rule in poisoning by corrosive sublimate.

Oxalic acid in concentrated solution is undoubtedly a corrosive and irritant poison. Very commonly, however, it kills by its depressing action upon the heart before symptoms of corrosion have become prominent; or the vomiting, pain, and other more immediate symptoms of corrosive poison are associated with a feeble pulse, clammy skin, nervous symptoms, aphonia, and speedy death, even within ten minutes of the administration of the poison. To quote Christison's language: 'If a person, immediately after swallowing a solution of a crystalline salt, which tasted purely and strongly acid, is attacked with burning in the throat, then with burning in the stomach, vomiting, particularly of bloody matter, imperceptible pulse, and excessive languor, and dies in half an hour, or still more in twenty, fifteen, or ten minutes, I do not know any fallacy which can interfere with the conclusion that oxalic acid was the cause of death. No parallel disease begins so abruptly and terminates so soon, and no other crystalline poison has the same effects.' It must be

added that binoxalate of potash, and the soluble oxalates generally, are as poisonous as the acid itself.

Anatomical Characters.—The distinction between corrosive and irritant poisons is by no means well-marked; and indeed corrosive poisons, when diluted, act as irritants. Hence we shall describe the *post-mortem* appearances of corrosive poisoning under the head of Irritants.

Diagnosis.—The diagnosis of corrosive poisoning rarely admits of difficulty; and in any obscure cases chemical analysis will remove all doubt.

2. **Irritant Poisons.**—Irritant poisons are of two classes—*metallic irritants*, and *vegetable* and *animal irritants*, these latter being grouped together. Perhaps none of them, however, act as pure irritants; and the irritant symptoms which they produce are most commonly accompanied by a well-marked effect upon the nervous system also. An irritant is a poison which causes inflammation of the part to which it is applied, usually the alimentary canal. By far the most important of the metallic irritant poisons is arsenic (*see* Arsenic, Poisoning by). Other metallic irritants are the salts of antimony, zinc, and other metals. Elaterin, essential oils, and gamboge may be cited as examples of vegetable irritants; and cantharides of animal irritants. Irritant animal and vegetable foods are separately described. *See* Poisonous Food.

Symptoms.—Irritants differ as a rule from corrosive poisons in the greater slowness with which the symptoms are developed. Usually when an irritant is swallowed, after an interval—greater or less according to the specific character of the poison—a burning pain is felt, and a sense of constriction of the mouth, throat, and gullet, speedily followed by sharp burning pain in the epigastrium; and this is increased by pressure—a mark which serves to distinguish the attack from one of ordinary colic. Nausea, vomiting, and great thirst ensue; speedily followed by pain and sense of distension of the whole abdomen, which is exceedingly tender, and perhaps visibly distended. Most commonly the vomiting is followed by purging, tenesmus, dysenteric stools, and often by dysuria. Should the poison not be speedily removed from the system by vomiting and purging, these continue unrelieved, and increase in severity; and symptoms of inflammatory fever, or it may be of collapse, supervene. The pulse becomes rapid, small, and thready; the countenance is anxious; the skin is bathed in perspiration, now warm, and again cold and clammy. The patient may never rally from the first shock to the nervous system; more rarely, having survived this, he dies in convulsions; or he may perish of inanition after more protracted sufferings. It must be borne in mind that those irritant poisons—such as diluted sulphuric acid—which, when taken in a more concentrated form, act as corrosives, may bring about starvation, necessitating such operative procedure as gastrotomy, by the injury which they inflict upon the œsophagus and stomach. Death after the administration of an irritant poison may, it is obvious, occur at very varying periods after the ingestion of the poison.

Diagnosis.—Irritant poisoning may be mistaken for various forms of natural disease. The diseases with which it is most apt to be confounded are—gastritis; gastric ulcer, with or without perforation; peritonitis; severe colic; sporadic and Asiatic cholera; and rupture of the stomach or intestines. A careful examination of the patient, and the history of the case, will often remove any doubt which may be entertained; but microscopical examination and chemical analysis of the ejecta of the patient will frequently afford the only means of clearing up the case during life. Too frequently irritant poison is not suspected until a *post-mortem* examination is made. In every case where a possibility of irritant poisoning is suggested, the aid of analysis should be invoked. For the diagnostic differences—so far as differences in symptoms are diagnostic—between irritant poisoning and the special diseases above mentioned, the reader is referred to the special articles in this Dictionary.

Anatomical Characters. — The *post-mortem* appearances in irritant and corrosive poisoning are corrosion of the mouth, fauces, gullet, and stomach, the mucous membrane being shrivelled, altered in consistence and colour, and more or less detached; irritation and inflammation of the stomach and first portion of the small intestines; ulceration; and erosion. In corrosive poisoning the stomach may be perforated, the edges of the aperture being shreddy; and in the case of sulphuric acid the viscera may be blackened (altered blood) from the action of the acid upon the blood-pigment. The small intestines are implicated to a varying extent, or may altogether escape. The large intestine may be attacked, and this is more especially the case in poisoning by mercurial preparations. Arsenic exerts a specific effect upon the gastric mucous membrane. Remains of irritants may be detected in the intestinal canal, and be recognised by their physical, microscopical, and chemical characters.

3. **Neurotic Poisons.**—Enumeration.—Under this head may be ranged a great number of poisons, having this in common, that the symptoms produced by them are more or less prominently associated with the nervous system. The class embraces pure narcotics, such as opium and morphine; hydrate of chloral; chloroform; hyoscyamus; digitalis; strychnine; prussic acid; nitro-benzol; phenol (carbolic acid); alcohol; aconite; belladonna, and many others.

SYMPTOMS.—These are necessarily of the most varied character. All that has been already said about the onset of symptoms, their character, and the circumstances under which they have appeared, must be borne in mind in arriving at a diagnosis.

Prussic acid produces its effects in the course of a few minutes; or, it may be, seconds. The course of symptoms is very rapid; and death may be well-nigh instantaneous. The symptoms are convulsions, great disturbance of respiration, with prolonged expiration, dilated pupils, and cyanosis. *See* PRUSSIC ACID, Poisoning by.

Morphine and *Opium*, after a stage of excitement, produce deep comatose sleep, with slow stertorous breathing; contracted pupils; and clammy, perspiring skin; all the other secretions being more or less suppressed. *See* OPIUM, Poisoning by.

Aconite is diagnosed by the peculiar numbness and tingling of the skin which it produces. *See* ACONITE, Poisoning by.

Belladonna, and its alkaloid *Atropine*, widely dilate the pupils, and cause intense thirst, with mirthful delirium and spectral illusions.

Chloroform and *Alcohol* in toxic doses produce profound insensibility; and are, moreover, generally more or less recognisable by circumstances, some of which will be found described under ALCOHOLISM.

Nitro-benzol causes symptoms often indistinguishable from those of prussic acid; but in consequence of its insolubility, and the slowness with which the liquid poison is absorbed by the gastro-intestinal mucous membrane, there is often a prolonged interval between the administration of the poison and the onset of alarming symptoms.

Hydrate of chloral causes death after a stage of unconsciousness; and there is scarcely any difficulty in ascertaining the nature of the case by the aid of the surroundings of the patient. *See* CHLORAL HYDRATE, Poisoning by.

Carbolic acid or *Phenol* whitens and shrivels the membranes with which it comes in contact, and not only acts as a corrosive, but produces speedy narcosis, and greenish or black urine. The peculiar odour of phenol is always perceptible, though not infrequently overlooked.

DIAGNOSIS.—It is impossible to enter fully into the diagnosis of each individual neurotic poison. The most frequent and important diagnoses have to be made in supposed cases of poisoning by opium, alcohol, and strychnine respectively.

In opium-poisoning the equally contracted pupils; the possibility of rousing the patient by means of external stimuli in all except the later stages—as, for instance, by flicking the feet, the application of the electric current, &c.; and the moist clammy skin, may serve to prevent the case being confounded with one of apoplexy. In alcoholic coma there is great danger of mistaking the nature of the case, in consequence of the frequency with which the alcoholic odour may be met with in cases where alcohol has been taken, either dietetically or medicinally, in moderate or somewhat immoderate doses. The very careful use of the stomach-pump can do no harm, and may not only save the patient if the case be one of alcoholic poisoning, but also serve to clear up the diagnosis. The tetanic spasms of strychnine will have to be differentiated from those of true (traumatic) tetanus. In this there is not usually any insuperable difficulty. Strychnine convulsions are intermittent; do not begin in the lower jaw; are, as a rule, opisthotonic in character, and do not affect the same groups of muscles as are implicated in true tetanus. *See* OPIUM, Poisoning by; and STRYCHNINE, Poisoning by.

TREATMENT.—Only the general principles of the treatment of poisoning can be indicated here. The treatment in poisoning by the most important special poisons is described in separate articles. The question of the use or non-use of the stomach-pump must be decided by the nature of the poison administered. Where one of the concentrated mineral acids, a caustic alkali, a corrosive salt, oxalic acid in concentrated solution, or carbolic acid, has been swallowed, it is generally held that the stomach-pump should not be used, the danger of perforation of the gullet or stomach being considerable. The soft œsophageal syphon tube may, however, be nearly always used with safety. In all cases where a non-corrosive poison has been taken, except in the case of prussic acid, where the course of the poisoning is too rapid to permit of the use of the instrument, the application of the pump is advisable and can do no harm; in cases of poisoning by opium and alcohol, the greatest reliance must be placed on evacuation of the stomach by its aid. The corroding acids may be neutralised by the administration of lime water, or, still better, saccharated lime water; highly diluted solutions of the caustic alkalis; or, failing these, the continuous use, in frequently repeated doses, of chalk, whiting, or the alkaline carbonates—so as to avoid dangerous distension of the abdomen with carbonic acid gas. On the contrary, the caustic alkalis may be neutralised by the copious imbibition of highly diluted acid liquids. Failing the use of the stomach-pump, or even after the use of this, emetics may be administered or apomorphine injected. The prompt administration of an emetic is perhaps never inadmissible. The effects of corrosives and irritants must afterwards be met by appropriate remedies, such as demulcents and oil to sheathe the mucous membranes, opiates to relieve pain, &c. The effects of oxalic acid cannot be avoided by the administration of

alkalis and alkaline carbonates, for the alkaline oxalates are themselves highly poisonous. Chalk, whiting, and soluble lime salts precipitate oxalic acid as an insoluble oxalate of calcium, and form the best remedies. Soluble sulphates are antidotes for carbolic acid. Oil greatly allays the intolerable pain attending the local action of this acid. In prussic-acid poisoning artificial respiration, persistently used, is our sheet-anchor, and may be supplemented by galvanism, alternate douches of warm and cold water, and other measures. After the use of the stomach-pump to remove unabsorbed opiates, stimulating liquids containing tannic acid, such as strong black coffee, may be given; and the patient must be kept awake by walking him about, flicking the feet with towels, the application of the faradic current, &c. Belladonna in full doses is in some respects antagonistic in its physiological action to opium. Conversely, opiates are regarded as direct antidotes to belladonna. On the same principle of counteracting effects, digitalis and aconite are counter-poisons, and hence antidotes the one to the other. The happiest results have followed the use of full doses of hydrate of chloral in strychnine-poisoning; and chloroform may be freely inhaled to allay the tetanic spasms. In alkaloidal poisoning, except where a tetanising poison, such as strychnine or brucine, has been given, the stomach-pump must be employed; and emetics and tannic acid, in the form of tincture of galls, strong black coffee, or strong tea, should also be given, with the object of precipitating the alkaloid as an insoluble tannate.

THOMAS STEVENSON.

POLYDIPSIA (πολύς, much; and δίψα, thirst).—A synonym for excessive thirst; sometimes used for diabetes. *See* DIABETES MELLITUS; POLYURIA; and THIRST.

POLYNEURITIS. — *See* NEURITIS, MULTIPLE.

POLYPHAGIA (πολύς, much; and φάγω, I eat).—A synonym for excessive hunger. *See* APPETITE, Disorders of; and PNEUMOGASTRIC NERVE, Diseases of.

POLYPUS (πολύς, many; and πούς, a foot).—SYNON.: Fr. *Polype*; Ger. *Polyp.*

DEFINITION.—This term is generally applied to any simple pedunculated growth, springing from a mucous surface; but it is sometimes extended so as to include malignant pedunculated growths in similar situations.

VARIETIES.—It is clear that no single description will apply to each member of the class. Hence it will be sufficient to enumerate the principal varieties of polypus, a fuller account of most of which will be found in the article TUMOURS, and also in connexion with the diseases of the several organs which they affect.

1. Polypi of the Nose.—These are of two varieties—the *mucous* and the *fibrous*; both are classed among the fibromata. Both are covered with ciliated epithelium. The fibrous variety often involves the structures at the back of the pharynx, forming the so-called *naso-pharyngeal polypus.*

2. Polypi of the Ear.—Polypi of the ear resemble polypi of the nose, but present a variety of structure, as some spring from the membrana tympani, others from the interior of the tympanum.

3. Polypi of the Intestines.—These polypi are of much more frequent occurrence in the rectum than in any other portion of the intestinal tract. They are composed of tissue resembling that of the mucous membrane of the part, and are described amongst the adenomata.

4. Polypi of the Uterus. — These growths are of three kinds, namely: (*a*) *cystic*, which are derived from the ovules of Naboth; (*b*) *mucous* or *soft*, resembling the polypi of the rectum; (*c*) *hard* or *fibrous* the so-called fibrous polypus of the uterus.

5. Polypi in other situations.—Less common forms of polypi, consisting of some modification of the mucous membrane from which they are derived, are found in the *bladder*, the *larynx*, on the *gums*, or sometimes in the *sinuses communicating with the nose.*

Malignant polypi present no special features which would enable them to be described as a class.

TREATMENT.—Though polypi differ somewhat in structure, the treatment of the simple varieties of the class is the same—that is, if removal be considered advisable. Either the pedicle may be grasped and the tumour removed by avulsion; or it may be divided at a stroke by some sharp instrument, or cut through slowly or rapidly by some form of écraseur or ligature.

In removing a malignant polypus a wide margin of healthy tissue must be taken away from around the pedicle.

R. J. GODLEE.

POLYSARCIA (πολύς, much; and σάρξ, flesh).—A term for excessive corpulence or obesity. *See* OBESITY.

POLYURIA (πολύς, much; and οὖρον, urine).—SYNON.: *Diabetes Insipidus*; Fr. *Polyurie*; *Diabète Insipide*; Ger. *Zuckerlose Harnruhr.*

DEFINITION.—A malady or group of maladies, characterised by thirst, and a persistently excessive flow of watery urine, which has a low specific gravity, and contains no albumin or grape-sugar.

Attempts have been made to subdivide this group into smaller sections. One such section is *polydipsia* or *hydruria*, having the characters above specified as those of polyuria; another is *azoturia*, where the solids,

especially urea, are in excess of the normal amount; and a third, *anazoturia*, where these are markedly deficient. The often-used term *polydipsia*, referring as it does specially to the symptom thirst, puts the effect before the cause. *Hydruria* points to the dilute character of the urine rather than to its excessive quantity. *Azoturia* has been made to include all cases where urea is unusually abundant, even where the urine is scanty, as in fevers; a condition totally averse to our notions of diabetes insipidus. *Anazoturia* very rarely occurs; for, notwithstanding the low specific gravity of the urine in polyuria, owing to the large amount passed, the quantity of urea may, and often does, exceed that excreted in health. A form of polyuria, often slightly marked, has been described as 'phosphatic diabetes,' on account of the excess of phosphates passed. The separation of these cases into a distinct group is hardly necessary. Certain factors in the above definition require special attention, the better to mark off the malady so defined from other pathological states. Thus the flow must not only be excessive, but persistently so. This separates polyuria from conditions where there merely exists a temporary flow of an unusual amount.

Ætiology.—Polyuria is limited neither by age nor by sex. It may exist in the newborn infant, and it may be found in the patient of seventy, but on the whole it is a disease of early adult rather than of advanced life, whilst it is about twice as frequent in males as in females. Nothing is more marked in connexion with the causation of polyuria than heredity. Perhaps the most extraordinary instance of this is recorded by Dr. Gee, where the disease was directly transmitted through four generations. Sometimes one member of the family escaped, but the children were sure to be attacked. A newborn infant, a member of this family, suffered from unusual thirst, so much so that water had to be given to relieve it.

Beyond inheritance, nothing very definite can be said as to the cause and origin of polyuria. It is often connected with nervous affections or nervous excitement, and sometimes follows upon injuries to the head or disease of the brain. Drinking bouts, too, have been credited with giving rise to the disease, as have drinking cold fluids, and sudden exposure to cold. Beyond those, no valid cause can be assigned; often indeed the disease comes on without even such insufficient reasons as those given above, some of which have doubtless been assigned on the *post hoc* principle.

Symptoms.—Not much need be said regarding the clinical history of polyuria. When the result of accident or mental emotion, its onset is usually abrupt, and it may end in like manner; sometimes as the result of intercurrent febrile disease. During its continuance thirst and watery urine are the two prime symptoms, for there may be little wasting, and the general health may be good. Occasionally there is increased appetite. Usually the bowels are confined, and the skin dry, though neither happens invariably. Pruritus and boils, so common in diabetes mellitus, are exceptionally met with in cases of polyuria. The condition of the patient is tolerable, so long as drink is supplied in plenty, were it not for the disturbed sleep caused by the incessant thirst and the desire to pass water; but any attempt to restrict the quantity of fluid gives rise to intense discomfort. Ultimately this constant strain wears out the patient, and may lead to death, if intercurrent disease do not carry him off.

Of the phenomena of polyuria, the urine alone requires special notice. It is inordinate in its quantity, and of a specific gravity little above that of water. It may remain persistently at 1001; but it may rise to as much as 1008 or 1010. It is transparent; almost like water; of a faint greenish-yellow tint; and with little taste, smell, or acid reaction. In quantity it varies with the amount of water consumed. If the patient is allowed to drink at will, the quantity passed corresponds broadly with that drunk, allowance being made for the watery vapour passing away by the lungs, and perhaps also by the skin. If the drink be restricted, more will be passed than is consumed, by the abstraction of water from the body. On the whole, the quantity passed is greater than in diabetes mellitus, and may sometimes be measured by gallons. Urea, though relatively deficient in any specimen of urine examined, has sometimes been found absolutely in excess, sometimes diminished. On the other hand, uric acid seems diminished, but this may depend on the difficulty of estimating it in urine so greatly diluted. Sulphates and phosphates, especially the earthy salts of the latter, are usually increased, whilst the only abnormal constituent, if such it can be called, said to have been detected is inosit; but the reactions of this substance, which has the same percentage composition as a sugar, but which belongs to the benzol series, are very unsatisfactory when occurring in urine. Acetone, oxybutyric acid, or other products of incomplete oxidation are never present.

Pathology.—As in the case of saccharine diabetes, our insight into the morbid processes concerned in the production of polyuria has been greatly aided by direct experiment. Bernard found that by pricking the floor of the fourth ventricle above the level of the 'sugar puncture' he could produce copious diuresis; and in certain animals injuries to the central lobe of the cerebellum (the vermiform process of human anatomy) are followed by a like result. From this part of the nervous system the nervous influence seems

propagated to the kidneys both by the splanchnics and spinal cord, but the exact course of the fibres has not yet been clearly demonstrated. Whether the nerves are merely vaso-motor fibres, section or paralysis of which would produce turgescence of the vessels of the kidneys, or trophic fibres, irritation of which would increase the activity of these organs, is not yet determined; but in all probability paralysis of the vaso-motor fibres is the main factor in the production of hydruria.

In the definition of polyuria given above disease of the kidneys was expressly excluded; and after death, as far as the malady itself is concerned, nothing is to be found except increased vascularity of these organs. As a consequence of the disease, however, persisting over many years, and giving rise to frequent and severe distension of the bladder, when circumstances may prevent its being emptied with sufficient frequency, thickening of the walls of the bladder, dilatation of the ureters, and sacculation of the kidney have been described; but the accuracy of such observations as the results of simple polyuria is questionable. Undoubtedly the most important lesions which bear on the disease are those which have been found in the brain, especially in the neighbourhood of the fourth ventricle. These, besides the injuries already alluded to, comprehend tubercular and other forms of inflammation, tumours of various kinds—gliomatous and syphilitic, together with other local changes.

Diagnosis.—The diagnosis of polyuria, according to the definition already given, is clear. It rests on these factors—thirst, and persistent excess of urine, coupled with the absence of grape-sugar and albumin. It has further to be carefully distinguished from mere temporary excess of watery urine. Such an excess may occur where a large quantity of fluid of a diuretic kind has been swallowed, especially when there is little or no cutaneous transpiration. Again, sudden flows of urine may occur about the period of early convalescence from fever, after the absorption of serous effusions, or yet again when a hydronephrosis suddenly empties itself. All these are merely temporary and evanescent states. The total absence of grape-sugar distinguishes polyuria from diabetes mellitus, though the one state may merge into the other. In certain forms of Bright's disease, especially those characterised by contracted kidney, the urine may be excessive and of low specific gravity; but in all of these albumin and casts will be at least now and again found. Finally, polyuria is not to be confounded with such abnormal discharges of urine as may occur from time to time in what we call hysteria and its allies. Here the nervous symptoms give a special feature to the malady; nevertheless polyuria has strongly marked nervous affinities.

Prognosis.—This cannot be called favourable, for, whilst few actually perish from the uncomplicated disease, still fewer are cured of it, though a good many get well. As a rule it runs a chronic course.

Treatment.—As might be inferred from the account of our imperfect knowledge of the pathology of the disease given above, the treatment of polyuria is most unsatisfactory. If the disease can be assigned to any definite cause, we must look to that and deal with it, rather than with the excessive urination; if not, it must be our endeavour to counterbalance the draining of the tissues, and the corresponding waste, by a plentiful supply of fluid and a generous nourishing diet. The distressing excessive thirst may be somewhat assuaged by sipping acid drinks. To relieve the kidneys from the unusual stress thrown upon them, diaphoretics have been recommended. Great care should be taken that the patient be warmly clothed so as to guard against any risk from cold. Of medicinal remedies, that which has been most lauded is valerian, especially by Trousseau, who gave it in enormous doses. The extract is the preparation usually prescribed. Probably it, like other antispasmodic remedies, would be found of most service in cases allied to hysteria or similar neuroses. The whole range of antispasmodic remedies may in some cases be tried without effect. Opium and its alkaloids, though serviceable in diabetes mellitus, are worse than useless in polyuria. They diminish the thirst and the urine, but they greatly increase the patient's discomfort. Valerianate of zinc, ergotin, iodide of potassium, belladonna, and phenazone have been tried with varying success. Tonics, especially strychnine and iron, do good by improving the general health. After every medicinal remedy has been tried in vain, attention to the constitutional state and change of air at the seaside may be followed by almost complete disappearance of the polyuria. Finally, the constant electric current, both weak and strong, has been advocated, and in the hands of some has done good, whilst it has equally failed in the experience of others.

Alexander Silver. John Harold.

POMPHOLYX (πομφός, a bulla or bladder).—This term is applicable to the bullous affection of the skin more commonly denominated pemphigus, of which it is, in fact, a synonym. *See* Pemphigus.

PONS VAROLII, Lesions of.—Synon.: Fr. *Maladies de la Mésocéphale*; Ger. *Krankheiten der Brücke.*

Introduction.—The pons is liable to a variety of affections, either by morbid processes having their primary seat here, or by secondary implication from disease originating elsewhere, as by tumours of the cerebellum

or base of the skull, or aneurysm of the basilar artery.

Tho position of the pons, its close relation to the vital centres of the medulla oblongata, the connexion of the sensory and motor paths with the cerebrum and spinal cord on the one hand, and the cerebellum on the other, and the transit through it of many of the cranial nerves, render the symptomatology of pontine affections highly complex and diversified.

Summary of Pathological Conditions.—*Hæmorrhage* in the substance of the pons is by no means uncommon, and may vary from a minute focus up to a complete disorganisation and rupture into the fourth ventricle. *Embolism* is not common; but *thrombosis*, from *syphilitic* or *atheromatous degeneration* of the basilar artery, is frequent, and is the origin of necrotic *softening* of an acute or chronic character.

Hæmorrhage.—Hæmorrhage into the substance of the pons, if of small extent, is not necessarily fatal; but if it be of large amount, death occurs suddenly, or within a very few hours. Sometimes there is a sudden onset of coma, with complete relaxation of the whole muscular system. The pupils are, as a rule, minutely contracted, and the condition resembles profound narcotic poisoning. The temperature may rise to as much as 105° F. or more. Deglutition is difficult or impossible; and death ensues from cardiac and respiratory paralysis, irregularity in the rhythm preceding the fatal issue. At other times, and of great signification from a diagnostic point of view, muscular spasms occur, either general or affecting one side more than the other, with distortion of the face, either from paralysis of one side, or this combined with active spasm of the other.

The occurrence of paralysis of one side of the face, and of the limbs of the other side, so-called 'alternate' paralysis, is pathognomonic of the pontine seat of the lesion.

Softening.—Acute embolic or thrombotic softening of the pons, with or without loss of consciousness, may lead to death rapidly, with similar paralytic symptoms; but days may elapse, or even months, after the first onset, with characteristic symptoms indicative of the position of the lesion, and death ensue either from gradual implication of the vital centres, or quite suddenly.

Localising Phenomena.—The symptoms most characteristic of lesions of the pons are a combination of paralysis of certain cranial nerves on the one side, and of tho limbs on the other. The most common combination is paralysis on onc side of the faco and of the limbs on the opposite, the faco being paralysed on the side of the lesion. The facial paralysis in this case resembles peripheral facial paralysis, both in the implication of the orbicularis oculi and dogenerative change in the muscles. The limbs may bo paralysed as to motion only, or thero may be a combination both of sensory and motor paralysis. Sometimes the motor paralysis affects one limb more than the other, and there may be a similar distribution of the anæsthesia.

The altcrnate paralysis of the face on one side, and of the limbs on the opposite, occurs more particularly with lesions of the pons situated towards the pyramids, at a point where the facial roots have not crossed over to pass on to the opposite hemisphere. If the lesion be higher up, near the crus cerebri, the face and limbs may both be paralysed on the side opposite the lesion. Amongst other varieties the face alone may be paralysed, without affection of the limbs; or one side of the face may be paralysed, and the other in a state of spasm; or both sides of the face may be paralysed; or one side of the face may be paralysed, and the limbs on both sides; or both sides of the face, and the limbs on one side. Spasms in the limbs paralysed or in the others may occur; and similar irritation of the sensory strands may be indicated by excentric hyperæsthesia and paræsthesia.

Along with the motor paralysis of the limbs, there is also a varying degree of vasomotor paralysis, and a difference in temperature of the limbs of one degree or more.

Next in frequency to affections of the facial nerve, with or without affections of the limbs of the variable character above mentioned, comes affection of the abducens or sixth cranial nerve. This gives rise to an internal strabismus, and usually of the eye on the same side as the lesion. There may be, therefore, paralysis of the face and abducens on the side of lesion, and of the extremities on the opposite side; but cases have been recorded of paralysis of the abducens on one side, and of the face and limbs on the opposite; and also of paralysis of the face, abducens nerve, and limbs on the same side as the lesion. In some cases there is conjugate paralysis of the abducens on the side of lesion, and of the internal rectus on the other. This occurs when the nucleus of the sixth is affected, which innervates tho external rectus of the same side and the internal of the other by way of the posterior longitudinal tracts. *See* case by Hughes Bennett, *Brain*, vol. xii. p. 102.

Defects in articulation are not infrequently observed, depending on impaired mobility of the tongue, usually on the side of the motor paralysis of the limbs, but apparently sometimos on the other side. The fifth cranial nerve is also not infrequently implicated Tho sensory portion seems to suffer more than the motor. But cases havo been recorded in which the motor portion of the fifth has been specially affected, leading to paralysis and degeneration of tho muscles of mastication.

The affection of the sensory division shows itself in more or less marked anæsthesia of the face, which may be general, or limited to the area of distribution of some of the branches only. The tongue is not infrequently affected on the same side, and tactile and gustatory sensibility impaired or abolished over the half of the tongue. The affection of the fifth may occur on the same side as the lesion, with or without affection of the limbs, but it would appear also that anæsthesia of the face may occur, with implication of the extremities on the side opposite the lesion.

There is thus an extraordinary complexity and variability in the symptoms which may be met with in connexion with pontine lesions. Those which have been mentioned are the most common and most significant, especially if they occur in combination. Singly they have less value, and some of them, particularly defects in articulation, are not specially characteristic. But a combination of paralysis of the limbs on one side, either motor alone, or of motility and sensibility, and of the face on the other, is significant of pontine lesion. The addition of paralysis of the abducens adds to the certainty.

Many other symptoms might be mentioned which have been noted in connexion with lesions of the pons, especially tumours, which ought perhaps to be ascribed to interference with the functions of neighbouring structures. As in other parts, however, tumours have been found invading or pressing on the pons without having given rise to any marked symptoms during life. But at other times, along with one or more of the previously mentioned symptoms, impairment of deglutition has been observed, due without doubt to pressure on the medulla oblongata. To the same cause should also be ascribed the irregularity and ultimate paralysis of the cardiac and respiratory movements, in connexion either with tumours or with hæmorrhagic effusions into the pons itself.

When a tumour presses forward in the direction of the crura cerebri, the third cranial nerves may be implicated. Ptosis has been observed in such cases; and external strabismus, from paralysis of the internal rectus, has also occurred, but comparatively rarely.

Vertigo and disorders of equilibration have been observed, but these may be attributed to an implication of the cerebellum or of its peduncles. Ataxic symptoms have, however, been described by Leyden as occurring in pontine lesions, without affection either of the cerebellum or of its peduncles. The writer has seen a case of very marked ataxy associated with anæsthesia of one side of the face, and of the limbs and trunk on the opposite side, due probably to lesion on the right side of the pons. But the cases which have been recorded are not yet sufficient to establish any very definite propositions in regard to the exact causation or special characteristics of the ataxic disorders in question. In connexion with tumours pressing on the pons, hearing may also be impaired or abolished in one or both ears. Impairment of smell has been observed on one side, when there has been anæsthesia of the face. This is probably due to the impairment of common sensibility in the nostril, intensified in some cases by the defective power of sniffing if the facial nerve is also paralysed.

Albuminuria and glycosuria have occasionally been found in connexion with diseases of the pons. It is very doubtful if any causal relationship has been at all satisfactorily established. Very often, when albumen has been found, there is good reason to believe that it has been pre-existing, for lesions of the pons frequently occur in connexion with chronic renal disease. Sugar has been found sometimes, and in other cases not. The same has been found in connexion with lesions of other nerve-centres. So far, therefore, as facts go, the evidence in favour of a direct relationship between pontine lesions and glycosuria is at present extremely slender, and in need of further investigation.

Diseases which encroach on the intracranial space produce the general symptoms of intracranial tumour, in addition to the special symptoms indicative of their invasion of the pons. D. FERRIER.

PORRETTA (La), in Italy, between Bologna and Pistoja.—Thermal, sulphurous, muriated saline waters. *See* MINERAL WATERS.

PORRIGO LARVALIS (*porrigo*, scurf; and *larva*, a mask).—*Porrigo* is an old-fashioned term, applied generally to eruptions on the scalp and face, whether exudative or desquamative; *larvalis*, masked, alludes to the covering of the face with an incrustation which conceals the features like a mask, such as is seen in a neglected exudative eczema of the face, an eczema pustulosum or impetiginodes. Pathologically, porrigo is an eczema. *See* IMPETIGO; and ECZEMA.

PORTAL OBSTRUCTION. — This is a condition of not uncommon occurrence, and calls for brief general discussion. Strictly speaking, portal obstruction implies that there is some direct impediment to the flow of blood in the portal circulation itself, either affecting the trunk of the vein before it enters the liver, or its branches distributed throughout the substance of this organ. It must be remembered, however, that any condition interfering with the circulation beyond the portal system, whether in the hepatic veins, the upper end of the inferior vena cava, right

side of the heart, or lungs, will retard more or less the flow of blood through this system; and also that either of the tributary branches of the portal vein may be affected alone. The portal trunk may be obstructed by direct pressure upon it, as by enlarged glands, a growth projecting from the liver, thickening from perihepatitis, or a neighbouring tumour, or aneurysm; by changes in its walls, leading to constriction or complete closure; or by blocking-up of its channel, as by a thrombus (*see* PORTAL THROMBOSIS). Cirrhosis is the most important disease which obstructs the portal circulation within the liver; but this result may also arise from accumulation of pigment and other causes.

EFFECTS.—The effects of portal obstruction will depend on its seat, its degree, and the rapidity with which it is set up. They are merely those which necessarily follow mechanical venous congestion, namely, distension of the small vessels, which may end in changes in their walls and varicosity; escape of serum; a congested or catarrhal condition of mucous surfaces; hæmorrhages; and, in course of time, permanent changes in organs and structures which are thus affected. Their localisation in this case will correspond to the structures from which the portal vein receives its tributary branches, or with which the latter communicate. Hence any of the following conditions may result in various degrees from portal obstruction: (1) Congestion and catarrh of the mucous membrane lining the lower end of the œsophagus, stomach, and intestines, with consequent disorder of the secretions; dilatation and varicosity of the small vessels; or hæmorrhage into the alimentary canal. (2) Ascites, one of the most frequent and evident phenomena. (3) Enlargement of the spleen, either from mere accumulation of blood, or in chronic cases with permanent increase and alteration in the splenic structure. (4) Congestion, followed by fibroid changes, in the pancreas. (5) Hæmorrhoids, it is generally believed. (6) After a while, enlargement of the superficial veins of the abdominal wall, owing to their communications with the portal vein; as well as of the veins within the abdomen, which are tributary to it. In rare instances peritoneal hæmorrhage has occurred from the rupture of distended veins. (7) Congestion of the female generative organs in some cases.

Several of the conditions mentioned are obvious on clinical examination during life; others are only evident on *post-mortem* examination, although they assist in originating symptoms, especially in connexion with the alimentary canal, such as those of dyspepsia, flatulence, and disordered bowels, diarrhœa being not uncommon. Hæmorrhage into the stomach or bowels is usually revealed by the occurrence of hæmatemesis or melæna, but it may prove fatal without any discharge of blood externally. It must necessarily happen that, if the portal circulation is not properly carried on, the functions of the liver are proportionately impaired.

The signs of portal obstruction may set in with great acuteness, or more or less gradually. Those indicative of acute obstruction are the rapid development of abundant ascites, returning speedily after paracentesis; acute enlargement of the spleen; hæmorrhage into the alimentary canal; and speedy dilatation of the superficial abdominal veins. It must be remarked that the most striking phenomena may disappear in chronic cases, after a time, without the removal of the obstruction, probably owing to the development of new channels, by which the blood is returned to the heart without passing through the liver. *See* HÆMATEMESIS.

DIAGNOSIS.—There ought to be no difficulty in recognising the signs of portal obstruction in marked cases; and it might even be suspected before these signs are well-developed under certain conditions. The cause of the obstruction can only be made out by a consideration of each case in all its features.

TREATMENT. — Rarely can anything be done directly to remove portal obstruction. The portal circulation may often be relieved by acting freely upon the bowels, especially by means of saline and hydragogue purgatives. Treatment directed to the effects of any obstruction is frequently highly efficacious, and the most important of these may be cured or relieved, even though their cause remain unaffected. The special treatment of these symptoms, and also of the conditions upon which portal obstruction depends, is described in other articles.

FREDERICK T. ROBERTS.

PORTAL THROMBOSIS.—SYNON.: Portal Phlebitis; Pylephlebitis; Fr. *Pyléphlébite*; Ger. *Pylephlebitis*.

Portal thrombosis may be divided into two kinds: (*A*) the **Adhesive**; and (*B*) the **Suppurative**.

(*A*) **Adhesive Portal Thrombosis.**—Adhesive portal thrombosis is seen most commonly in cirrhosis of the liver, rarely as a cause of the cirrhosis itself. In the first case, it arises, not from an inflammation of the walls of the vessel, but from obstruction to the circulation. The thrombus itself is usually firmly adherent to the walls, tough, and of a red-brown colour, the vein being dilated. In very rare cases thrombosis of numerous peripheral branches of the portal vein, as the mesenteric veins, has been found giving rise to symptoms very similar to those caused by thrombosis of the trunk of the vein.

SYMPTOMS. — The symptoms of portal thrombosis are those of intense portal obstruction. There is ascites, rapidly developing itself, and, according to Frerichs, returning

rapidly after removal by tapping. The veins of the walls of the belly become rapidly dilated. There may be hæmatemesis or a bloody diarrhœa. The spleen is greatly enlarged. Jaundice may or may not be present.

DIAGNOSIS.—The diagnosis of portal thrombosis is a matter of great difficulty, the symptoms being very like those of cirrhosis, of which, indeed, it is often a mere complication. In general, it is only when the thrombosis is very acute and affecting the trunk or most of the branches of the vein, and causing very rapid ascites, splenic tumour, dilatation of the superficial abdominal veins, &c., that a diagnosis can be made.

PROGNOSIS AND TREATMENT.—The prognosis is always bad. Instances of recovery are extremely rare, in which cases the vein has been found converted into a fibrous thread, and a collateral circulation established. The treatment must be the same as for cirrhosis in most cases. In the very acute cases, leeches over the liver, cupping, and the administration of saline purgatives should be tried.

(*B*) **Suppurative Portal Thrombosis.**—*Pylephlebitis Purulenta.*—Suppurative portal thrombosis is commonly met with in connexion with some morbid process, most often suppuration, in the parts from which the branches of the portal vein arise. Thus, diseases of the intestines, especially of the cæcum and its vermiform appendix, are the most frequent causes. It has been seen by one of the writers caused by a needle fixed in the vermiform appendix; and Frerichs has recorded a case where a needle perforated the inferior mesenteric vein. It occurs after dysentery, and more rarely after enteric fever. It is occasionally caused by ulcer and cancer of the stomach, and follows suppurative splenitis. In the newly born, suppuration sometimes extends from the umbilical vein to the liver. The vein is found greatly dilated, and filled with a dirty grey or reddish pulp, which, under the microscope, shows small round nucleated cells like pus-corpuscles. The liver itself shows, on section, the branches of the portal vein filled with a diffluent thrombus, so that the organ looks as if pervaded with abscesses.

SYMPTOMS.—The symptoms closely resemble those of abscess of the liver or of pyæmia. Traube thinks the diagnosis may be made if the liver and spleen be much enlarged, and if there be returning attacks of rigors with raised temperature, while between the attacks the temperature is natural or only slightly raised. Remittent pyrexia, with sweating, vomiting, diarrhœa, and rigors, are the most constant symptoms. The liver, however, is only moderately enlarged in some cases. Pain and tenderness in the right hypochondrium, with an icteric tint, in a case presenting pyæmic symptoms, should suggest this condition. There must be also evidence of some suppuration, which may involve the branches of the portal vein; and pyæmia and endocarditis must be excluded. Often, however, all these signs fail, and suppuration of most of the branches of the portal vein has been found after death when no hepatic symptoms have been present during life. Possibly the occurrence of hepatic symptoms depends upon the acuteness of the process.

Remembering, however, how frequently it is caused by disease of the appendix, any suspicion of pylephlebitis should lead to the careful consideration of the propriety of surgical exploration of the appendix.

PROGNOSIS AND TREATMENT.—The prognosis is always bad; the treatment must be the same as for abscess of the liver or pyæmia.

J. WICKHAM LEGG.
STEPHEN MACKENZIE.

POST - MORTEM EXAMINATION.—*See* NECROPSY.

POST - MORTEM WOUNDS. — SYNON.: Dissection-wounds; Fr. *Blessures Anatomiques*; Ger. *Sectionwunden.*

DEFINITION. — A variety of poisoned wounds, arising from the inoculation of a virus derived from the dead bodies of men or animals.

Similar consequences may result from the inoculation of the discharges from unhealthy inflammations in living bodies, especially those arising from *post-mortem* poisoning. The conditions necessary for the production of a dissection-wound are the virus, a means of entrance of the virus into the system, and a condition of body favourable to the development of the effects of the virus.

PATHOLOGY.—*The virus.* — The products of ordinary decomposition may cause local troubles, to be mentioned hereafter, but they never give rise to the graver forms of *post-mortem* or dissection wound. The poison is present in greatest intensity in fresh bodies, and its virulence diminishes as decomposition advances. It is not the same in all cases, and the effects vary greatly with the nature and intensity of the virus. We are not in a position to deny that in some cases the virus may be a non-organised ferment, but it is practically certain that in the vast majority of *post-mortem* wounds it is a pathogenic organism, and most commonly one of the micrococci. In the localised forms the staphylococcus pyogenes aureus or albus is most commonly found, while in the diffuse varieties, in which the lymphatics are chiefly implicated, the streptococcus pyogenes is almost invariably present (*see* ERYSIPELAS). *Post-mortem* wounds of a serious character most commonly arise from inoculations from the bodies of patients who have died from some unhealthy inflammatory (infective) process, especially from septic peritonitis or pleurisy, pyæmia, septicæmia,

puerperal fever, diffuse cellulitis, erysipelas, or spreading gangrene. The diminution of the intensity of the poison with decomposition is probably due to the destruction of the specific organism by the growth of the ordinary bacteria of putrefaction; it being a well-known fact that when two organisms are growing together in the same fluid, the stronger overpowers the weaker, checks its growth, and finally leads to its destruction.

Certain specific diseases, as glanders and splenic fever (malignant pustule), may be communicated by inoculation from the dead body, but these accidents are not classed with ordinary dissection-wounds.

Mode of entrance of the poison into the system.—Whatever the virus may be, it only acts by direct inoculation. This most commonly occurs through an accidental wound or scratch during the *post-mortem* examination; but a raw surface partly healed, or the fissures in chapped hands, or the small fissures so common at the margin of the nail, may serve as points of inoculation. In rare cases infection takes place through the unbroken skin, the hair-follicles seeming then to serve as the points of entrance. The further diffusion of the poison takes place by spreading amongst the lymph-spaces of the cellular tissue, as shown by diffuse cellulitis; by being carried with the stream in the lymphatic vessels, as in those cases in which the local affection is slight, and the first trouble is in the lymphatic glands; or by entering the blood-stream and setting up a general infective process.

Prevention.—In order to prevent inoculation the following points should be attended to. Before making a *post-mortem* examination of a dangerous case the hands should be carefully looked over. If any spot denuded of cuticle be found on the fingers, an india-rubber cot should be applied, its base being bound round with string. If the whole hands are sore and chapped an india-rubber glove may be used. If no india-rubber cot for a finger is to be found, an efficient waterproof covering may be made at once with gutta-percha tissue and chloroform. If the hands are sound they may be well greased with carbolic oil (1 to 10), but, as this soon wipes off, the application must be repeated several times during the *post-mortem* examination. Carbolised vaseline may be used instead of the oil, and is less easily rubbed off. Accidental wounds arise almost invariably from carelessness—the assistant being as often wounded as the operator. There is scarcely any operation in a *post-mortem* which requires two to perform it, and an assistant should therefore be dispensed with. The most common acts of carelessness are—cutting towards instead of away from the left hand; and letting the knife fall unobserved into one of the cavities, where it is concealed by blood or the viscera, and wounds the hands when next introduced. Wounds from ribs are amongst the most dangerous, as they bleed but little. To avoid these, when using the bone-forceps in cases of ossification of the cartilages, the ribs should be cut near the nipple line, and the skin folded over them whilst the viscera are being examined. In opening the head the saw is apt to slip, and to injure the hand holding the vault. To avoid this, either wrap the hand in a thick cloth, or hold the head with the left hand on the face, where it will be out of danger. Punctures during the sewing-up of the body have caused many deaths. These injuries are usually due to using too small a needle, which cannot be kept properly under control. A common packing needle sharpened is by far the safest instrument that can be used. In whatever way the wound is made the first essential of treatment is to make it bleed freely. If it is on the finger, this may be done by winding a piece of string round it from the root to the tip; then wash it thoroughly in carbolic lotion (1 in 20) or perchloride of mercury (1 in 500) and suck it. Caustics are quite unnecessary if these directions are carried out. After a *post-mortem* examination the hands should always be well washed in some strong antiseptic solution.

The condition of body favourable to the development of the effects of the poison.—Nothing is more common than for two persons to be wounded at the same *post-mortem* examination, and only one to suffer from it. Sir James Paget has brought forward strong evidence to show that constant exposure to the poison gives a certain degree of 'immunity from the worse influences of the virus,' and that one dissection-wound protects the sufferer from another, at least for some time. Anything which causes a depressed state of health favours the occurrence of *post-mortem* poisoning. Thus, we see it in students who have been some months resident in hospital, in nurses who are worn out with attending a bad case, and in dissecting-porters or others who indulge too freely in alcohol. Beyond these, no special predisposing conditions are known.

Varieties.—It will be convenient to discuss the several forms of *post-mortem* wounds under distinct headings according to the following arrangement:—

1. Purely Local Affections.

(*a*) *Dissecting-porter's wart*, or *anatomical tubercle.*—Although not exactly a *post-mortem* wound, this affection must be mentioned here as being one of the effects of the irritation caused by the repeated application of putrid matter to the skin. It is seen only in those whose occupation brings them much in contact with decomposing animal matter, and is of very rare occurrence. Its seat is always at the back of the

hand over the knuckles, or the joints of the fingers. It is characterised by a warty thickening of the skin, which may in some cases resemble epithelioma. In other cases the thickening of the cuticle may give the skin an ichthyotic appearance. The enlarged papillæ are set closely together, and there is no true ulceration, but cracks and fissures may exist in parts, from which a serous discharge escapes. The growth tends slowly to spread. These warty growths are usually multiple, and this, together with the want of any tendency to ulceration, will serve to distinguish them from epithelioma.

Treatment.—Salicylic collodion applied daily will usually effect a cure. In other cases the constant use of wet dressing to soften the epithelium, combined with the application of a mixture of equal parts of glycerine and extract of belladonna, is of great service. Should this fail, painting with strong tincture of iodine may be tried, or, as a last resource, the application of some strong caustic.

(b) *The dissecting-room pustule.*—This is always the result of the inoculation of some poisonous matter into a slight abrasion or puncture. About twenty-four hours after inoculation the spot becomes red and itches. In another twenty-four hours a small drop of pus is seen raising the cuticle, and the part is intensely tender. If the drop of pus be let out the pain is at once relieved. If no treatment be now adopted to prevent it, a small scab forms, under which pus again appears, and the redness and pain return as before. Each time that this happens the sore increases in size, till it may reach about one-eighth of an inch in diameter, and it then closely resembles in appearance a small soft chancre. Without treatment the condition may continue indefinitely. It is very seldom accompanied by any constitutional disturbance. The axillary glands may be tender, but suppuration is rare, except in unhealthy subjects.

Treatment.—The best application to these sores is lint wetted with a lotion composed of solution of the subacetate of lead 1 part; rectified spirit 1 part; water 6 parts. The dressing must be kept constantly moist, so as to prevent the formation of a scab, and the shutting in of the pus. The treatment must be continued until the sore is soundly healed. If the smallest speck be unhealed it will relapse as soon as the dressing is removed. If, in spite of this dressing, it refuse to heal, nitrate of silver may be applied, or the ulcerated surface may be covered with iodoform.

(c) *Suppuration of the matrix of the nail.* This arises from inoculation through one of those small fissures at the side of the nail popularly known as 'agnail' or 'hangnail.' The inflammation extends rapidly to the matrix at the root of the nail. The dorsal aspect of the finger for half an inch below the nail is swollen, red, and acutely tender, and on pressing over this area pus oozes out over the nail. The inflammation rarely extends over the whole matrix, so that the distal part of the nail is usually unaffected and firmly attached, while the root is softened and loosened by the suppuration beneath it. The discharge has a strong offensive odour of decomposition. This condition is extremely chronic, the irritation being kept up almost indefinitely by the putrid discharge, which is more or less pent up beneath the nail. When recovery takes place the nail usually separates.

Treatment.—The first essential of treatment is, if possible, to render the discharges aseptic. For this purpose the finger may be soaked in the lead lotion before mentioned, or in a saturated solution of boric acid in cold water, and dressed with the lead lotion and boric-acid lint; or powdered iodoform may be pushed with a piece of card beneath the swollen skin over the root of the nail. If these simpler means fail, the nail must be removed; and the raw surface, dressed with some mild antiseptic lotion, will quickly heal.

(d) *Suppuration of the hair-follicles.*—This is a somewhat rare effect of *post-mortem* poisoning. About forty-eight hours after exposure to infection a varying number of small pustules, each surrounded by a red areola, form on the hairy parts of the hands and wrists. On careful examination, each pustule will be seen to have a hair passing through it. As a rule, these pustules discharge and dry up without causing further trouble, but in some exceptional cases they may be followed by constitutional symptoms or lymphatic inflammations.

Treatment.—All that is necessary is to cover the part with cotton-wool, to hasten the drying of the pustules.

(e) *Boils.*—Boils, which differ in no respect from those arising without known cause, may form as a consequence of exposure to *post-mortem* poisons. They probably start from inflammation of the hair-follicles.

Treatment.—This presents nothing special.

(f) *Ordinary whitlow.*—Although whitlow is common amongst nurses and others whose duties oblige them to dress foul sores, it is not a very common consequence of *post-mortem* wounds. When met with it presents nothing special. *See* Whitlow.

2. Diffuse Inflammation of the Cellular Tissue, spreading from the point of inoculation.

(a) *Diffuse cellulitis.*—The seat of inoculation becomes in from twelve to twenty-four hours more or less red and irritable, and in this state it may remain for another day, at the end of which time a brawny swelling of a dusky red colour forms round it, and rapidly extends in all directions, but chiefly

in the line of the lymph-stream. At the same time there is intense tension, burning pain, and severe constitutional disturbance, high temperature, total loss of appetite, and possibly delirium. Red lines of inflamed lymphatic vessels may or may not be seen extending upwards, but glandular abscesses are rare, as in ordinary cellulitis. If unrelieved by treatment, sloughing rapidly follows the brawny swelling, first of the subcutaneous tissue, and afterwards of the skin.

Treatment.—The only treatment in such a case is free and early incision into the affected part. In one case which came under the observation of the writer the inoculation took place from a scratch from a broken rib which had penetrated a consolidated lung, and caused the formation of a foul abscess. Swelling in the finger commenced on the second day, about 10 p.m., and at 11 a.m. on the following morning it had involved the whole finger and part of the back of the hand. Red lines extended from it a little way above the wrist. Two incisions were immediately made in the palmar aspect of the finger, and one on the dorsum of the hand, with the effect of at once arresting the extension of the process. In this case the attack commenced with slight nausea, but no chilliness or rigor; there was high fever and delirium on the third and fourth days. The constitutional treatment must be the same as in other cases of diffuse cellulitis. *See* Erysipelas.

(*b*) *Spreading gangrene.*—This is an intensification of the preceding variety. A red, brawny swelling advances rapidly up the arm, quickly followed by gangrene of the subcutaneous cellular tissue and skin. This condition is extremely rare as a consequence of dissection-wounds. A case occurred in 1880, at University College Hospital, under the care of Mr. Heath, in which the patient's life was only saved by amputation at the shoulder-joint. It happened to a nurse from an accidental wound received whilst laying out the body of a patient who had died of puerperal fever.

Treatment.—Early amputation above the advancing gangrene is the only treatment.

3. Inflammations chiefly affecting the Lymphatics.

(*a*) *Inflammation of the lymphatic vessels.*—This usually commences from twenty-four to forty-eight hours after inoculation. The seat of inoculation may show scarcely any signs of inflammation, or it may have developed into a small suppurating sore. The invasion of the lymphatic inflammation is marked by elevation of temperature, chilliness, or possibly a rigor. There is malaise and often nausea, with headache. Red lines are soon after observed running upwards from the seat of inoculation in the course of the lymphatic vessels. These lines are about one-eighth to one-quarter of an inch in width, and clearly defined. They are acutely tender. The lymphatic glands to which they lead are swollen and painful. If unrelieved by treatment, suppuration frequently occurs in the lymphatic glands, or sometimes in the course of the vessels. Occasionally several lines may fuse together, giving the appearance of a band of cutaneous erysipelas.

Treatment.—The bowels should be well opened. Stimulants in moderate quantities may be taken, good port wine being especially useful, with strong beef-tea, milk, and eggs. If there is much fever, quinine may be of use in reducing the temperature. Locally, the whole course of the inflamed vessels is to be painted with a mixture of glycerine and extract of belladonna in equal parts, and the whole arm wrapped in hot fomentations, which must be frequently renewed. This treatment seldom fails to arrest the progress of the inflammation, and ward off suppuration. If pus forms, either in the course of the vessels or in the glands, it must be let out as soon as it is recognised.

(*b*) *Abscess in the lymphatic glands.*—This occurs either as a consequence of the previous condition or without any evident inflammation of the lymphatic vessels. It is frequently a complication of one of the local forms first described. The abscess forms either in the gland at the bend of the elbow or in the axilla, and presents no special features requiring description. The prognosis is not grave.

Treatment. — The abscesses must be opened as soon as recognised, and treated antiseptically.

(*c*) *Axillary cellulitis.*—This is one of the gravest effects of a *post-mortem* wound. It frequently occurs in cases in which the local affection at the seat of inoculation is so slight as to be scarcely recognisable. From twenty-four to forty-eight hours after inoculation the patient is seized with chilliness, and frequently a rigor; there is great depression; with nausea, or even vomiting, and headache. The temperature rapidly rises, reaching 104° or 105°, and there is frequently delirium. On examining the axilla some fulness, with acute tenderness, is recognised, and there is pain in moving the arm. The fulness soon extends to the front of the chest, in the region of the pectoralis major, and the veins of the region may become more clearly visible than natural. Later on there may be a blush of redness over the pectoral region, and with this there is œdema. If not relieved the swelling and redness may extend down the side of the chest, and show above the clavicle at the root of the neck. The constitutional condition assumes the ordinary characters of septicæmia. There is muttering delirium, rapidly failing pulse, dry tongue, with sordes on the lips and teeth, possibly diarrhœa, and the patient sinks into a comatose condition and dies. Sir James Paget,

in his well-known lecture on his own case, explains this condition by supposing that the lymphatic glands are first swollen, and the flow of lymph through them obstructed, and that the poison then extends backwards in the distended lymphatics till it reaches the cellular tissue in which they arise, thus causing diffuse cellulitis, which, if not relieved, or if not speedily fatal, may extend to the whole area which sends lymph to the affected glands. If an incision be made early into the affected cellular tissue it will be found merely infiltrated with serum; later on the serum is turbid; still later the whole areolar tissue would be found in a sloughy condition, soaked in pus.

TREATMENT.—The blood-poisoning accompanying this condition is frequently fatal in spite of any treatment. The only hope for the patient lies in early recognition of the state of the part, and in making free incisions. These incisions must thoroughly open up the axillary fascia, and if there be any suspicion of extension beneath the pectoralis major, another incision must be made two, or even three, inches in length, through the muscle. This is best made in the interval between the sternal and clavicular portions. The skin and fat only need be divided with the knife, the muscular fibres being separated with the handle of the scalpel to avoid hæmorrhage. If these incisions are made with all antiseptic precautions and the antiseptic dressing adopted, the patient's chance of life is greatly increased. The constitutional treatment consists in free stimulation and abundant nourishment. Quinine may possibly be useful in large doses.

4. **Septicæmia.**—In some cases, which fortunately are very rare, *post-mortem* wounds prove speedily fatal, with the ordinary symptoms of acute septicæmia. Local changes at the seat of inoculation may be entirely wanting. *See* SEPTICÆMIA.

5. **Pyæmia.**—Pyæmia may occur as a secondary complication of the forms of *post-mortem* wound which are accompanied by suppuration and sloughing; but it presents nothing special in such cases. *See* PYÆMIA.

MARCUS BECK.

POST-PHARYNGEAL ABSCESS.

See RETRO-PHARYNGEAL ABSCESS.

POSTURE.—In this article it is intended to point out the main practical relations of posture to the ætiology, diagnosis, and treatment of various diseases. It not uncommonly happens that a patient assumes instinctively a posture by which his condition may be at once recognised, or which gives indications of importance as to his management. In other cases the practitioner makes systematic use of posture to assist him in his diagnosis, or to aid him in treatment. It should be mentioned at the outset that persons often present peculiarities with reference to posture, which are of no practical significance, and are the result either of natural differences in individuals, or of habit. For instance, some people can only sleep with the head raised very high, in an almost semi-recumbent position; others lie with the head very low, even level with or below the body. Many are unable to sleep on the back, or on one or other side, and especially the left side. The subject will be further discussed in its relations to the several points mentioned above.

1. **Ætiology of Posture.**—As an immediate cause of disease, posture is chiefly important in connexion with occupation. For instance, many persons suffer from long-continued standing; or, on the other hand, from sedentary occupations. The evil effects of prolonged standing are evidenced by the development of varicose veins in the legs, and also by the occurrence of general fatigue and debility, displacements of the uterus, and other conditions, especially in young women, such as those employed in drapers' shops. Those callings which entail constant or frequent bending forward of the body are often very injurious, and this may be aggravated by carrying burdens on the back and shoulders. Not uncommonly persons injure themselves by habitually bending forward when sitting, quite apart from occupation. Another illustration of the influence of posture in causing disease is where individuals have to work in constrained positions, such as colliers and miners. The conditions thus induced are chiefly deformities of the chest, and certain diseases of the lungs, heart, and vessels. Hanging down the head may be the determining cause of cerebral apoplexy. Posture is also of consequence in predisposing to certain affections under particular circumstances, or in modifying their effects. Thus the recumbent posture in low febrile and other conditions aids in the causation of hypostatic congestion and its consequences; a similar position promotes the accumulation of morbid products in the smaller bronchi or air-vesicles, in cases of severe acute bronchitis, which may cause further mischief; and if an attack of pleurisy should supervene when a patient is obliged to lie on his back, this will materially modify the way in which the fluid accumulates, for it tends then to collect posteriorly, and may cover the whole area of the chest in this aspect, while there is no sign of any fluid in front. Lastly, a peculiar posture in performing certain acts, such as writing, may have some influence in originating affections of the type of writer's cramp.

2. **Posture in Diagnosis.**—As examples of postures spontaneously adopted by patients, which may give useful information in diagnosis, the following are the most striking.

In many cases the posture suggests great debility, helplessness, or prostration, thus affording important indications as to the general condition of a patient. An inability to lie down constitutes a prominent feature in certain forms of cardiac and pulmonary disease, in consequence of interference with the respiratory and cardiac functions, so that the patient is obliged to sit or to be propped up in bed, or sometimes even to sit up in a chair, to assume the erect posture, or to bend forward. Again, when anything is pressing upon the main air-tube—such as an aneurysm—causing obstructive dyspnœa, the patient may instinctively lean forward, so as to take off the pressure as much as possible. In cases of unilateral lung-disease or pleurisy, the patient is often unable to lie on one or other side, especially the affected one; while in affections of the heart it is frequently impossible for him to rest on the left side. As regards abdominal diseases, acute peritonitis is usually characterised by a very striking posture, the patient lying on his back, with the knees well drawn up and bent, in order to relax the abdominal muscles. Certain positions may also be assumed in other abdominal affections, on account of their influence upon symptoms, such as pain or vomiting. In spasmodic painful attacks connected with this region, it is very common to see the patient bending forwards in a doubled-up position, and pressing upon the abdomen. In nervous diseases posture may be of conspicuous value in diagnosis. Thus, it may reveal paralysis of different parts; in cerebral meningitis the patient often lies in a curled-up position, all the limbs being bent towards the body; in spinal meningitis the head may be involuntarily drawn backwards, in order to try to relax the muscles behind; in tetanus the body is during the spasm fixed in different positions, according to the muscles affected; in cataleptic conditions any posture that is assumed is retained for a considerable or an unlimited time; whilst in wry-neck the head is turned to one side. Lastly, the position voluntarily assumed by a limb may give important information as to local diseases or injuries likely to influence it in this respect, such as those of the joints. The whole body may be distorted, as well as the limbs, in connexion with diseases of the articulations.

What has just been stated will supply hints as to how the practitioner might avail himself of *changes in posture* in aiding him towards a diagnosis in certain cases. For instance, observing the effect of such changes often gives valuable information in connexion with pulmonary and cardiac diseases, as evidenced by the influence of the respective positions upon breathing, cough, the heart's action, and other symptoms; and the same may be the case in some abdominal diseases, as well as in nervous affections or in local diseases. Change of posture is most useful, however, as an aid to physical examination, the effects it produces upon certain physical signs being noted. In this way it may give valuable help in determining the presence of fluid in cavities, such as the pleura or peritoneum; in distinguishing an internal aneurysm from conditions simulating this lesion; in detecting certain solid formations in the abdominal cavity; and for other purposes. Details on these points are given in appropriate articles. It is also of importance to study the position of the patient in examining the chest; and to remember that posture may materially influence physical signs connected with the heart.

3. **Posture in Treatment.**—Many of the preceding remarks will afford suggestions as to the value of paying attention to posture as a therapeutic measure, and it will at once be evident that if a wrong posture is the cause of any morbid condition, the first principle in treatment should be to rectify it. Besides, it will not uncommonly be found advantageous to watch patients, and to allow them to adopt, or assist them in adopting, such a position as their own sensations dictate to be the most suitable for their condition. In order to illustrate further, however, the benefits to be derived from posture, it may be well to point out some of the diseases in which its value is most strikingly exhibited.

(*a*) Posture is of great importance when general rest of the body is required, or when there is exhaustion or prostration of the whole system. The recumbent posture is clearly indicated under these circumstances, for it is the most restful of all, and involves little or no expenditure of muscular force. Hence, in acute febrile diseases of all kinds, one of the first indications in treatment is to keep the patient absolutely in bed. This is also desirable where there is excessive fatigue or prostration from any cause. The great importance of rest in bed during and after an attack of influenza may be specially noted.

(*b*) In the management of affections connected with the respiratory organs, attention to posture is frequently of service. Here its influence as regards rest again comes in, for it may be of much consequence to make as little call as possible upon the respiratory functions. Moreover, symptoms associated with the breathing apparatus are in many cases strikingly influenced by posture, such as pain, dyspnœa, or cough (*see* Resuscitation; and Stertor); and the act of coughing may be materially assisted, and made more effectual as regards expectoration, by the patient assuming a sitting or erect position. The importance of the prone posture, or of bending forwards, must be remembered when there is anything pressing on the main air-tube.

(*c*) Posture often requires particular consideration in relation to disorders of the cardiac action, or to actual disease of the heart. Thus, in the syncopal state the patient should be placed horizontally, or even with the head at a lower level than the body, so that the blood may more readily reach the brain, and in this way life may be sustained. Bending the head downwards between the knees may prevent threatened syncope. In this state, or when the heart is acting with extreme feebleness from any cause, raising the patient into a sitting posture has been known to cause a fatal result, and should be carefully avoided. On the other hand, there are conditions of the heart in which the patient cannot possibly lie down, and especially where there is much dilatation; under these circumstances it may be of the greatest service to have him constantly sitting up in a properly constructed chair, and the beneficial effects thus produced are sometimes almost marvellous.

(*d*) In the treatment of aneurysms, whether internal or external, posture is frequently made use of with advantage. In the cure of this lesion in the chest or abdomen, rest is often an important agent, and on this account patients are confined to the recumbent posture for weeks or months, so as to keep the heart as quiet as possible, and also to limit the demand of the system for food, which is only given in a restricted quantity. Aneurysm in the chest is one of the causes which may originate pressure on the air-tube, and on this account attention to posture may be required in connexion with it. In the case of aneurysm in the limbs, posture is sometimes made use of to cure them, by causing pressure, as flexion of the knee for the cure of popliteal aneurysm.

(*e*) The influence of posture with respect to gravitation may often be recognised with advantage in the treatment of certain conditions. This is well exemplified by its effects on dropsical accumulations in the legs and scrotum. Even abundant anasarca may frequently be got rid of completely in a short time by keeping the legs in a horizontal position; and œdema of the scrotum likewise may soon disappear when this part is propped up. The same principle is of essential importance in checking hæmorrhage from a ruptured varicose vein in the leg; and may also be made use of in the cure of varicose veins. The influence of posture upon dropsy may give useful information as to its cause, and as to the exact conditions upon which it depends.

(*f*) As miscellaneous illustrations of the employment of posture in treatment may be mentioned the value of the recumbent position in sea-sickness, in attacks of giddiness, megrim, and neuralgic affections about the head; raising the head in comatose conditions; the prone posture in the treatment of certain forms of spinal disease; prolonged decumbency or peculiar positions to restore a displaced uterus; and various positions in which limbs are placed on account of local diseases, to relieve pain, to prevent muscular tension, to promote the escape of pus, or for other purposes.

(*g*) Lastly, it must be remembered that it is not uncommonly requisite to change the position of a patient more or less frequently, if he should be confined to his bed. For instance, this is necessary in low febrile diseases, in order to prevent the occurrence of hypostasis at the bases of the lungs, or the formation of bed-sores on parts subjected to pressure; as well as in many cases of spinal or cerebral disease, and in very emaciated patients. Change of posture is further useful in assisting the escape or expulsion of morbid secretions from the air-passages, when they tend to accumulate there.

FREDERICK T. ROBERTS.

POUGUES, in Loire, France.—Alkaline chalybeate waters. *See* MINERAL WATERS.

POULTICE (πόλτος, porridge; *puls*, thick soup).—SYNON.: Cataplasm; Fr. *Cataplasme*; Ger. *Breiumschlag*.—Poultices are soft moist applications, usually applied hot, but occasionally cold. They may be used merely as a means of applying heat and moisture; or they may contain some drug intended to exert a specific effect. Of the innumerable poultices formerly in use, only six are now officinal.

Poultices may be arranged thus: 1. The *simple* poultice, composed of linseed meal. The practice of using bread soaked in hot water as a poultice has deservedly fallen into disrepute, as it soon becomes sour and offensive. 2. *Disinfecting* poultices, namely, cataplasma carbonis, and cataplasma sodæ chlorinatæ. 3. *Sedative* poultices, such as cataplasma fermenti and cataplasma conii. 4. The *counter-irritant* poultice, for example, cataplasma sinapis.

1. **Simple Poultice.**—The simple poultice, by its heat, causes a dilatation of the vessels of the part to which it is applied, and thus hastens the progress of inflammation, either towards resolution or suppuration. It softens the cuticle, and relaxes the skin by its moisture, and thus favours swelling, and lessens tension and pain. In internal affections, such as bronchitis, pleurisy, or pericarditis, large poultices are frequently applied to the skin over the inflamed part. They benefit the patient partly by their warmth, and partly by exerting an extremely mild counter-irritant effect, consequent upon the redness and congestion of the skin which they produce. They are, however, somewhat troublesome; they soon become cold and hard; and if the patient be restless, their weight causes

them to shift, and fragments break off and drop into the bed, and there drying cause considerable discomfort. For application to external inflammations a few folds of lint, soaked in hot water or any appropriate lotion (sedative, stimulant, or antiseptic), covered with oil-silk, and afterwards with a thick layer of cotton wool, will be found to answer every purpose of a poultice, and to be much more cleanly and less troublesome.

Linseed-meal poultices applied to boils usually cause a fresh crop to spring up round the original boil, from the irritation they give rise to. They should consequently never be used, wet boric acid lint or salicylic wool moistened with boiling water being substituted. In internal inflammations a poultice may often be advantageously replaced by cotton-wool only, covered with oil-silk and secured by a bandage. If any counter-irritant action is required, a few drops of chloroform or turpentine may be sprinkled on the wool.

Linseed-meal poultices are best made from meal from which the oil has been expressed, as the pure meal becomes rapidly rancid. The *British Pharmacopœia* recommends the addition of a little olive oil. The following is a useful method of making a linseed-meal poultice: Heat the basin in which the poultice is to be made with boiling water; then empty it and put into it again as much boiling water as may be necessary to make the required poultice; sprinkle the meal into the water, stirring vigorously, till the proper consistence is attained; lastly, stir in a small quantity of warm olive oil. By adopting this plan the poultice will be free from lumps. The poultice should then be spread with a broad spatula on a piece of rag or tow. It must be of a uniform thickness, and neither so thick as to be too heavy, nor so thin as to cool and dry too rapidly. A poultice should be changed every two or three hours by day, and every four at night, if the patient is sleeping. In all cases where there is suppuration, a poultice is the dirtiest application that can be made to the wound. Wet boric acid lint or some other moist antiseptic dressing should always be used instead.

2. **Disinfecting Poultices.** — *Cataplasma carbonis* is a horrible compound of wood-charcoal, linseed meal, and bread, and was formerly supposed to have some disinfectant properties. Both this and the *cataplasma sodæ chlorinatæ* have been entirely replaced by more cleanly or efficient antiseptic applications. The best of these are boric acid lint, salicylic wool, and carded oakum. If carded oakum be used, it must be made into a soft and even pad, and may be dipped in hot water before being applied. It is a powerful antiseptic, and very cheap, but has the disadvantage of blackening the skin with the tar it contains, and sometimes causes considerable irritation. Both these inconveniences may be overcome to a certain extent by greasing the skin with carbolic oil (1 to 10).

3. **Sedative Poultices.** — *Cataplasma fermenti* is composed of beer yeast, 6; flour, 14; water (100° F.), 6. After mixing, it is to be placed near the fire till it rises. The carbonic acid was credited with both sedative and antiseptic properties. It was chiefly used in boils, but from personal experience the writer can state that it has none of the virtues attributed to it. *Cataplasma conii* is composed of juice of hemlock, 1 ounce; linseed meal, 4 ounces; and boiling water, 10 ounces. Evaporate the hemlock juice to half its volume, and add to the linseed meal and water previously mixed and stir them together. It has been chiefly used in cases of cancer to relieve pain.

4. **Counter-irritant Poultice.**—*Cataplasma sinapis*, the ordinary mustard poultice, is an invaluable counter-irritant. It is composed of mustard in powder, 2½; linseed meal, 2½; boiling water, 10. The linseed meal is to be mixed with the water, and the mustard added, constantly stirring. It must be remembered that mustard varies much in strength, and that since it has been made the object of the special attention of the authorities engaged in carrying out the Adulteration Act, its strength has considerably increased. Its action should extend only to producing redness of the skin, for if kept on too long it will cause vesication, and has even been known to give rise to sloughing. The time a mustard poultice can be kept on varies from ten minutes to half an hour or more, according to the strength of the mustard. The guide most usually relied upon are the sensations of the patient. An ordinary patient is not likely to keep it on too long, as the smarting soon becomes unbearable. Patients who are much in the habit of applying mustard poultices to the same part—as, for instance, the front of the chest—acquire a singular power of resistance to the irritative action of the mustard. The mustard poultice is indicated whenever mild and rapid counter-irritation is desired. It is especially useful in bronchitis, and in muscular rheumatism, as lumbago or pleurodynia. Rigollot's mustard-leaves, and the *charta sinapis* of the *British Pharmacopœia*, are excellent substitutes for the mustard poultice. They are cleaner, more easily applied, and can be more accurately adapted to the spot required. They should always be used in preference when obtainable.

Marcus Beck.

PRÆCORDIAL ANXIETY or OPPRESSION

—Synon.: Fr. *Angoisse*; Ger. *Präcordialangst.*

Definition.—A sensation of constriction, attended with anxiety, referred to the præcordia; for the most part persistent, but at times recurrent.

Ætiology.—Anxiety or oppression of the præcordia is due to dilation and inhibition of the right side of the heart, more especially of the auricle; whereby, though the walls of the heart in structure are unimpaired, their elasticity is neither duly excited nor supported.

The *predisposing* and *exciting causes* are, for the most part, to be found in an abnormal condition of the blood, so that the due nutrition of the heart, whether as regards muscle or nerve, is not supplied nor its contractile power effectually excited; and also (though the duration of the attacks may not be so persistent as in the above form) in a flatulent and distended stomach and alimentary canal, exciting to inhibition, both locally and reflexly—through efferent impulses descending the vagus. Though there may thus be deficient innervation, whereby the irritability of the heart is impaired, it does not appear to be a simple neuritis, but mainly dependent on some abnormal condition of the muscular functions temporarily established, an impure blood failing to stimulate the fibres to a due expansion and contraction, or flatulent distensions directly or indirectly, in like manner, interfering with these functions.

Description.—Præcordial anxiety shows itself by a distressing sensation in the region of the heart, characterised by an irregular rolling, tumbling, or falling motion, supervening on a feeling of constriction. It is accompanied by feelings of anxiety; by restlessness, which may pass into a state of extreme agitation; by a sensation of approaching syncope, with fear of death; and by chilliness passing into a cold clammy perspiration. Though there may be a soreness or dull aching, there is neither pain nor palpitation, and it appears to have no alliance with real præcordial pain. The urine is not increased, but rather diminished. Sleep is impossible. The attack often comes on during sleep, and soon, perhaps, the restless anxiety necessitates rising from the couch and walking about; often flatulence oppresses, and gas is evolved, with relief to the symptoms. The attacks are recurrent, and of varying duration. Though præcordial anxiety is here only referred to, as uncomplicated with organic disease, it should be borne in mind that the heart may not be altogether free from indications of more than functional disorder. *See* Angina Pectoris.

Treatment.—During the attack relief is generally obtained in locomotion, and in occasionally administering small amounts of some diffusible stimulant or warm carminative, camphor and the compound spirit of ether being specially applicable. In the intervals fresh air, attention to dietetic rules, the free evacuation of the bowels without purging, and light nervine bitters, will be found useful.

T. Shapter.

PRÆCORDIAL PAIN. — Synon.: Heartburn; Fr. *Cardialgie*; Ger. *Magenschmerz.*

Definition.—Pain referred to the region of, but not originating in, the heart; not paroxysmal, but occasionally recurrent.

Ætiology.—Præcordial pain has its origin mainly in morbid sensibility of the intercostal and pneumogastric nerves, and secondarily in the nerves of the brachial plexus and the cerebro-spinal nerves supplying the front of the thorax. The *immediate* cause of this affection is an abnormal and morbid sensibility of the several nerves implicated. It has its *predisposing* cause more often than otherwise in an ill-directed and low mental condition, and where healthy physical exertion is neglected, malnutrition, the hysterical temperament, the broken constitution of the gouty and rheumatic, and low forms of dyspepsia largely predispose to it.

Description.—Spasmodic præcordial pain may vary from a slight uneasiness to an intense anguish. It notably differs in character; it may be sharp and lancinating, dull and heavy, twisting, or grinding. Its seat may be defined, or it may be diffused over a large surface. It is met with mainly in persons of a nervous temperament, in the gouty and dyspeptic, in the course of certain of the blood-diseases, and as an accompaniment of special female disorders. A common seat of this pain is the left fourth intercostal space below, or, rather, outside, the line of the nipple. The patient associates it with the heart; and yet describes it as not so deeply seated, nor in any respect influenced by its action—having no rhythmical exacerbations; generally it is confined to this spot, but may be diffused over the chest. A severe form of this pain, though for the most part confined to the outer region of the heart, often extends from the præcordia to the left shoulder, the neck, and the stomach; sometimes, though rarely, to the arms. These several forms of pain have analogies with each other, their differences being mainly in seat, in intensity, and in their complications with other disorders; they are irregularly remittent; they do not partake of the nature of cramp or spasmodic constriction; and apparently they have little or no influence on the heart's action, or on that of the respiratory organs. For the most part, though their manifestation may be severe, and therefore alarming to the patient, they do not, simply and unassociated, indicate the presence of disease of a fatal tendency. They are to be esteemed as capable of alleviation, and generally of cure. If there be danger, it is chiefly due to complications with organic disease of the heart, or other contiguous organs; they partake of the nature, and obey the laws, indications, and phenomena, of ordinary nerve-pains, such as tic-douloureux, or those of sciatica or lumbago.

TREATMENT.—The treatment of these affections requires that their origin, seat, intensity, persistency, and complications should be well considered; each being a measure of disorder, and a guide to the means of alleviation. The severe form of pain, whether persistent or recurrent, which appears to have its seat mainly in the branches of the vagus nerve, is essentially due to malnutrition, and of a low dyspeptic origin, marked by flatulence and acidity, and requires, with well-regulated diet and exercise, very careful medical management. The indications for the most part are to correct the acid or gouty diathesis. Alkalis and the alkaline mineral waters, light bitter infusions, and warm alterative aperients, are often most useful in these cases. The intercostal pain is somewhat persistent and difficult of alleviation, and requires, besides attention to the morbid states with which it may be associated, whether these be the hysterical, the dyspeptic, the plethoric, the hypochondriacal, or the emaciation and weakness of exhausting diseases, strict regulation of diet and exercise, with residence in a pure air. The pains originating in disordered conditions of the blood usually find relief in the treatment laid down for their alleviation. T. SHAPTER.

PRÆSYSTOLIC.—A term implying antecedence to the ventricular systole, and used in connexion with a cardiac murmur or thrill occurring during this period of the cardiac revolution. *See* HEART, VALVES AND ORIFICES OF, Diseases of; and PHYSICAL EXAMINATION.

PREBLAU, in Carinthia, Austria.—Acidulated alkaline waters. *See* MINERAL WATERS.

PREDISPOSITION TO DISEASE. DEFINITION.—That state of the body which renders it peculiarly liable to be affected injuriously by a morbific agent; determining in the case of a 'non-specific' agent the particular disease which it shall induce in each of several individuals similarly exposed to it; whilst, in the case of a 'specific' agent or 'morbid poison,' it determines the relative liability of several individuals, similarly exposed to it, to become the subjects of the particular disease it is capable of originating, and also influences the severity of the attack.

Thus, of several persons equally exposed to severe cold, which, by chilling the general surface, produces contraction of the cutaneous capillaries and consequent internal congestion, some shall not suffer seriously in any way; but one shall be attacked by bronchitis, another by pneumonia, another by apoplexy, another by gastro-intestinal disturbance, another by nephritis, another by gout, and so on, according to the part of the body which the congestion most affects in each individual.

Again, of several individuals equally exposed to the poison of cholera, some shall escape altogether, whilst others shall be attacked by choleraic disease: and of the latter, some may suffer only from diarrhœa; in others nothing more may be induced than vomiting, cramps, and rice-water evacuations; whilst in others the disease may develop itself in its full intensity, and rapidly proceed to a fatal termination.

Predisposition may be either *congenital* or *acquired*; and in the former case—unless induced by malformation, or by causes acting through the maternal system during pregnancy—it is usually *hereditary*.

Hereditary predisposition to disease seems to follow the same modified laws of heredity as the transmission of *family* peculiarities. These do not imply the same duration or universality in the action of the causes which have evolved them as do the characters of species and race; and consequently, whilst tending to perpetuation if the parentage on both sides be limited to such as participate in them, they tend on the other hand to die out by free interbreeding. Still, we often see a family feature, or some other physical or mental peculiarity, 'cropping up' after a dormancy of several generations; thus clearly evidencing the transmission of a potency, which manifests itself whenever some deficient condition has been supplied. So there are certain constitutional states or *diatheses*, which particular abnormal habits of life tend to induce, when their operation continues with cumulative force through successive generations. These, when fully established, so penetrate the entire organism, that perhaps no one process goes on exactly as it would in perfect health. And, when they have once firmly rooted themselves in it, they tend to propagate themselves hereditarily like family characters, even when the original factors have ceased to act, but still more when they continue in operation. Of this we have a conspicuous instance in the hereditary transmission of goître, and its gradual aggravation into cretinism, among the inhabitants of those Alpine valleys in which a close stagnant atmosphere, privation of sunlight, bad ventilation of dwellings, filthy personal habits, and some other local conditions not yet understood, have concurred, through a long succession of generations, to engender the constitutional state which expresses itself in these forms of disease.

So, the fullest evolution of the gouty, the scrofulous, or the cancerous diathesis may require the continued action of their factors for several successive generations; it may be interfered with by the introduction of normal factors by intermarriage; and during its progress the manifestation of these diatheses

may be so trivial as to attract but little notice. But when either of them has been fully established by the sufficiently prolonged action of its causes, its hereditary transmission, like that of family peculiarities, becomes the rule rather than the exception, save in so far as it is modified by interbreeding. And even where it seems to have died out, never showing itself in the spontaneous production of any its characteristic forms of disease, it shall modify the course of almost any other malady, or complicate the results of some accidental injury. Where both parents are the subjects of the same well-marked diathesis, the transmission of it to the offspring is almost a certainty; and the manifestation of it is likely to be yet more marked, if the parents inherit also the same *family* idiosyncrasies.[1]

Although the predisposition to *insanity* is often undoubtedly hereditary, it does not seem to partake of the constitutional nature of a diathesis, except where it depends on the existence of one of the definite forms of malnutrition already specified. The fact seems to be that the nervous system is so peculiarly liable to be shaped and modified by the mode in which it is habitually called into exercise, that it takes-on a particular *abnormal* form of activity far more readily than any other organ; and thus, when a special form of malnutrition has once established itself, this may be transmitted to the offspring without the prolonged action of its special factor through many successive generations. We see this particularly in the effect of habitual alcoholic excess, which not only produces a tendency to insanity in the subject of it, but also engenders in the offspring (especially when *both* parents are drunkards) a disordered state of brain-nutrition, which may express itself in idiocy, epilepsy, alcoholic craving, mental instability, weakness of will, uncontrollable hysteria and the like, as well as in insanity. And the same may be said of abnormal moral habits, which, when they have fixed themselves in the cerebral organism, tend to reproduce themselves in succeeding generations; as we see illustrated in a very striking manner in hereditary kleptomania.

But of all these acquired forms of disordered *neurosis* it may be said that, as it is the peculiarity of the nervous system rapidly to grow to the mode in which it is habitually exercised, so there is less tendency to the hereditary perpetuation of such disorder than where it depends upon an established diathesis, provided that the right methods of physical and moral invigoration are employed for the restoration of the normal activity of the brain.

Although it can scarcely be doubted that various other acquired predispositions tend to reproduce themselves in the offspring, there are none which do so with any approach to the constancy and definiteness which are exhibited by those which have become 'constitutional'; and they may, therefore, be dismissed without special notice.

Among the diseases produced by the action of specific poisons, there are some to which the hereditary predisposition must be said to be *universal*; the cases in which these poisons are imbibed for the first time without producing their characteristic effects being quite exceptional. In this category are to be ranked the exanthemata, and probably syphilis. Dismissing the latter as limited in its propagation by the speciality of its mode of transmission, we recognise the universality of the predisposition to the former in the extraordinary manner in which any exanthem introduced into a community, whose isolation had prevented its invasion for a long previous interval, spreads through a whole population.[1]

But the original liability to any of the exanthemata appears, as a rule, to be extinguished by one attack of it; the cases being exceptional in which the poison develops itself a second time in the body of anyone who has once *fully* exhibited its characteristic effects. And the liability is greatly diminished, and the severity of the second attack usually much mitigated, even when the first action has been incomplete—as is often seen in epidemics of measles and scarlatina. This seems the *rationale* of the 'protection' afforded by vaccination against small-pox; there being (in the writer's opinion) no reasonable doubt that the vaccine virus is nothing else than small-pox poison modified by transmission through the cow,

[1] The worst case of this kind that the writer ever saw or heard of, was where the parents were first cousins—children of two brothers who were both gouty, and who belonged to a family noted for the strong personal and mental resemblance of its members.

[1] Thus, in 1846, the poison of measles having been conveyed to the Faroe Islands, where it had been unknown for sixty-five years, the disease rapidly spread among their inhabitants, affecting old and young alike; more than 6,000 persons out of a total of 7,782 were attacked by it in the course of six months; and scarcely any escaped, save the few aged persons who had been affected when young in the previous epidemic, and the inhabitants of one of the smaller islands, who kept up a rigid quarantine. The Icelandic records (which have been well kept for many centuries) show a similar prevalence of any exanthem that has been introduced after a long interval. Thus in 1707, out of a total population of about 65,000, no fewer than 16,000 (or nearly one-fourth) *died* in an epidemic of small-pox; so that it can scarcely be doubted that, as in the previous case, almost every individual exposed to the poison must have been *attacked* by the disease, unless he had previously been the subject of it. Thirty-four years had elapsed since the disease had been last known in the island; and many persons who had had it before, took it a second time.

and that the protective influence of vaccinia is thus of the same *kind* as that exerted by a first attack of variola, though perhaps rather lower (unless re-vaccination has been practised) in *degree.*

Much light has during recent years been thrown on this subject by parallel researches in epizoötic diseases; for it has been found that the poisons of splenic fever and fowl-cholera can be modified in like manner by 'cultivation'; and that the inoculation of these modified poisons produces in the subjects of it very mild forms of those diseases, which serve as a protection against their malignant attacks. And it may now be laid down with tolerable certainty (1) that the blood of an individual who has been the subject of any of those specific diseases which usually occur only once in life, is so altered (whether by addition or subtraction), that it is no longer liable to be acted on by the same poison; and (2) that this alteration may be produced, and 'protection' imparted to the subject of it, by even a greatly mitigated form of the disease, such as may be induced by the introduction of artificially modified poison. It may not, Sir Joseph Lister thinks, be too sanguine an anticipation, that means may ere long be found for so tempering the poisons of measles and scarlatina, as to make an innocuous 'vaccination' afford a similar protection against their worst effects.[1] *See* IMMUNITY.

Acquired predisposition.—Any habitual infraction of the laws of health will induce a *general* liability to disease, by producing a depressed condition of the vital activity, whereby the organism is rendered less capable of resisting the influence of morbific agents. But this infraction may be of a kind which induces a liability to some particular disease; as when the habit of rapidly eating a large meal tends to injure the digestive power; or the habit of living in over-heated rooms predisposes to bronchial and pulmonary attacks.[2]

It is, however, in determining the invasion and epidemic spread of diseases that depend upon the zymosis set up in the blood by the introduction of certain specific poisons, that the effect of 'acquired predisposition' is most distinctly seen, and can be most definitely expressed. During the severest visitation of cholera or diphtheria, for example, the number attacked is really small in comparison with the entire population; and while, of those who escape, the great mass may be assumed not to have been exposed to the action of the poison at all, yet it is unquestionable that a large proportion of those who are as fully exposed as those attacked by the disease, do not become the subjects of it. A medical practitioner, again, may unconsciously carry about with him a septicæmic contagium, which is innocuous, not only to himself, but to a large proportion of the persons with whom he comes into contact; and yet it may take fatal effect upon certain individuals, who, nevertheless, have received no stronger dose of the poison than the rest. Further, it is not infrequently seen that the practitioner or nurse who long seems completely 'proof' against any attack of the epidemic malady to which he (or she) is ministering, at last succumbs to it. It is clear, in these and similar cases, that there must be some 'predisposing condition' not supplied by the normal human body, which determines the zymotic action of the *materies morbi* in the individuals who manifest its effects.

Such 'predispositions' have been recognised and specified by all who, at various times, have scientifically studied the ætiology of epidemics; and it has been universally noted that unwholesome food, bad water, and foul air have exerted a singular potency in favouring the action of the poison on individuals and communities. The advocates of the 'germ theory' and of the 'chemical theory' of zymotic poisons are at one in regard to this fact—that the presence of nitrogenous matter, in a decomposing or readily decomposable state, affords the best possible pabulum, either for the development of bacillar organisms, or for the action of ferments. And, building on this foundation, the writer long since[1] came to the conclusion, that the common condition which all those agencies tend to produce, which experience has shown to be specially favourable to the development of zymotic disease, is this: The presence, in the blood of the individual attacked, of an excess of those decomposing effete matters, with which the circulating current is normally charged to a limited amount, during their passage from the parts of the body in which they are poured into it, to the excretory organs by which they are eliminated and cast forth. If the amount of these matters be limited to that which is being continually generated in the ordinary waste of the body, and if the great emunctories (the lungs, the liver, the intestinal glandulæ, the kidneys, and the skin) all do their proper work, the products of that waste are drawn off from the blood-current

[1] See his address 'On the Relation of Micro-organisms to Disease,' in *Quart. Journ. of Microscopic Science*, April 1881.

[2] The writer was informed by Mr. Gulliver, when surgeon in the Life Guards, that the young powerful men of his regiment, mostly sons of Yorkshire farmers, suffered greatly from bronchitis and pneumonia; in consequence, he believed, of their liability to become chilled on going out into cold air, after being shut up for many hours a day in stables unduly heated for the purpose of imparting sleekness to the coats of the horses. The animals themselves suffered in like manner.

[1] See his Paper on 'The Predisposing Causes of Epidemics,' in the *Brit. and For. Med. Chir. Review*, vol. xi. (1853), p. 159.

as fast as they are poured into it, so that the stream is kept pure. But if, on the one hand, such decomposing matters be either abnormally introduced from without, or be generated in abnormal amount within the body; or if, on the other hand, the normal process of elimination be in any way obstructed; or if, still more, an abnormal excess of the one process concurs with deficient activity of the other, a rapid accumulation of these matters takes place in the blood; and this, by providing the pabulum requisite for the development of the poison, supplies the very condition necessary for its morbific activity.

Of the effectiveness of the introduction of putrescent organic matter, either in food, water, or air, the cholera epidemic of 1848–9 afforded instances so glaring that they here need only to be adverted to.

Of the even more marked potency of the excessive generation of effete matter within the body, we have a typical example in the extraordinary proclivity of the *puerperal female* to suffer from the action of any septic poison to which she may be exposed.[1] Nothing can be plainer to the physiologist, than that the return of the uterus, after parturition, to its non-pregnant condition, involves a rapid 'waste' of its muscular substance, the products of which will be poured into the blood-current far more rapidly than they can be eliminated; this state continuing until the process is completed. The like condition exists in subjects of severe injuries, and of operations; and not only do these exhibit a special proclivity to the action of specific poisons like scarlatina (the disease only then declaring itself, although its germs must have been previously received and lain dormant),[2] but they show a peculiar liability to suffer from the ordinary septic poisons which have no effect upon the healthy carriers of them, erysipelas and adynamic 'surgical fever' being thus communicable.[3]

Excessive exertion, again, whether bodily or mental (such excess being marked by the feeling of fatigue), has always ranked among the most potent of predisposing causes; and its action is clearly traceable to the same source, the abnormally rapid 'waste' of the tissues whereby the blood-current becomes unduly charged with the products of their disintegration.[1]

[1] This proclivity was never more strikingly displayed than in the former experience of the Vienna Lying-in Hospital, where a comparison of the mortality in the two sides of the institution, one attended by midwives, and the other by medical students, showed that an annual average of from 400 to 500 deaths out of 3,000 deliveries was distinctly traceable to the unclean habits of the latter, who were accustomed to come into the wards fresh from the dead-house. The enforcement of proper precautions soon lowered this excessive mortality to the standard of the other side.

[2] Sir James Paget, in *Brit. Med. Journ.*, 1864, vol. ii. p. 237.

[3] Sir James Simpson, in *Edinb. Monthly Journ.*, vols. xi. and xiii.

Ample evidence is afforded by army experience of the special liability of soldiers to zymotic disease, when on long and fatiguing marches; and this especially in hot climates, where, the activity of the respiratory process being reduced by the high external temperature, the products of the waste tend to accumulate in the blood-current.

Of the predisposition induced by the accumulation of effete matter consequent upon obstructed elimination, none is more marked than that which results from overcrowding. The effect of defective air-supply is not only to reduce the quantity of carbonic acid got rid of by expiration, but also (which is probably of yet greater importance in relation to zymotic disease) to diminish the normal oxidation of those nitrogenous effete matters, of which (when thus metamorphosed) it is the special business of the kidneys and skin to get rid. The accumulation of these within the body speedily makes itself manifest in the offensiveness of the halitus of the breath (the condensation of which shows the presence of fœtid matter) and of the cutaneous transpiration; and thus, although there may be no introduction of decomposing matter into the body, or specially rapid internal production of it, the blood-current becomes as effectually charged with the pabulum of the zymotic poison as if this had been injected into it.[2]

[1] It is within the experience of everyone, that the sense of fatigue bears no constant proportion to the amount of exertion put forth; and that whilst, on the one hand, any obstruction to the eliminating processes (as by bad ventilation of the sleeping apartment) prevents its removal by rest, an unusually severe and prolonged strain may be sustained without its induction when the excretory apparatus is stimulated to increased activity, as in 'training.' And there is strong reason, therefore, for regarding this feeling as indicative of the degree in which the blood is charged with the products of nervo-muscular waste.

[2] Thus it has come about, that, while the average mortality of European troops in India under favourable circumstances does not exceed 30 per 1,000, it has been raised at particular stations through a long succession of years—solely by overcrowding in ill-ventilated barracks—to 75 or even 100 in the 1,000; whilst in certain Indian gaols, in which the air-space was actually at one time less than 100 cubic feet per prisoner, the mortality rose to an annual average of *one in four*.

A most remarkable instance of the combined action of the two last-named predisposing causes, resulting in the *double*-charging of the blood with the pabulum most suited to the development of zymotic poison, was furnished by the terrible outbreak of cholera, which carried off *one-eighth* of the troops stationed at Kurrachee in 1846; no fewer than 464 deaths having then occurred out of a total strength of 3,746. Some of the troops (*a*) had recently come off a long and fatiguing march, but were well accommodated in airy barracks; and their loss was at the rate of 96·6 per thousand. In another regiment (*b*), which had not been on the march, but was overcrowded in small ill-ventilated tents, the

The strong predisposition to zymotic disease induced by intemperance, which has been no less conspicuously manifested in the experience of our Indian army, seems clearly traceable to the same source. For the habitual presence of alcohol in the blood-current undoubtedly diminishes the oxidation of the waste-products, and thus occasions their accumulation in the system; and this at a greater rate in hot climates than in cold, on account of the already reduced activity of the respiratory process in the former. Where, again, the rate of waste is abnormally increased—as on the march of troops—the evil influence of alcoholic liquors is still more strongly manifested; and this will be again aggravated by overcrowding in tents or barracks.[1]

On the connexion between famine and pestilence it is unnecessary to enlarge; but it affords the keystone of our cumulative argument. For in whatever way it is to be accounted for, the fact is certain, that a state of general blood-contamination is produced by the accumulation of non-eliminated products of waste. In the Irish famine of 1847, the fœtid secretions from the skin, the rapid supervention of general putrescence after death and its manifestation even previously, and the frequent termination of life by colliquative diarrhœa, all evidenced the peculiar fitness of the body so conditioned for the development of a zymotic poison.

And thus we seem furnished with a scientific *rationale* for all that experience has taught as to the conditions of the spread of zymotic disease; which, by giving greater definiteness and consistency to medical doctrine, will afford a surer and more positive basis for preventive hygiene, both public and individual.

But whilst it is specially in establishing a predisposition to zymotic disease, and in aggravating the severity of its attacks, that the contamination of the blood-current by the accumulation of waste-products most strikingly manifests itself, there can be no doubt that it lowers the healthy vigour of the body generally, and thus renders it more ready to be affected by any disease to which it may be constitutionally liable. Where any form of malnutrition exists—whether resulting from imperfect performance of the primary digestive processes, producing ill-made blood, or from imperfect conversion of blood into tissue—there must be premature degeneration and augmented 'waste'; and the rate of this augmentation must tend to increase, if special attention be not given to the eliminating processes. Here we have the *rationale* of the fundamental importance of pure fresh air, as cool as it can be borne, to the scrofulous subject; and of the remarkable cures sometimes effected in patients in whose lungs tubercular deposit has already commenced, by the hazardous discipline of a hardy outdoor life. When any serious malady has once established itself, the degeneration of tissue, as shown in the rapid wasting of the body, takes place with augmented rapidity; and the necessity for the removal of its products is proportionately urgent. And this is not the less important when the progress of the disease is stayed; for the purification of the blood from the contamination it has received is absolutely essential to the establishment of those recuperative processes on which the final issue depends. Of the due elimination of the waste-products, their oxidation is the first and most fundamentally important act; and of the direful consequences of past ignorance and neglect of this principle—evinced on a large scale in the overcrowding and bad ventilation of hospitals, poorhouses, and gaols—their records too surely tell. Even now our practice is far from perfect in this particular; and it is scarcely going too far to affirm that, not only the public, but the medical profession, have still much to learn as to the importance of an ample supply of pure air, both for the prevention and the cure of disease.[1]

WILLIAM B. CARPENTER.

rate was 108·6 per thousand. And in a third (*c*), which had made the march like *a*, and were overcrowded like *b*, the mortality was 218 per thousand, or at a rate actually exceeding their high rates added together.

[1] Of this, Dr. Parkes's experience as assistant-surgeon to the 84th Regiment in India, afforded a striking illustration. A large proportion of the men of this regiment were total abstainers, and the remainder were very temperate. During the year 1846–47 it was quartered for eight months in the healthy barracks of Fort St. George, Madras; it then performed a march of between 400 and 500 miles to Secunderabad, in a very wet and unhealthy season, through a country infested with fever and cholera; and the remaining two months were spent in overcrowded barracks at Secunderabad. Yet the mortality during that year was only 13 in an average strength of 1,072, or at the rate of 12·1 per 1,000. Continuing during the next year in the same overcrowded barracks, its loss was raised to 34·9 per 1,000; but this was *less than half* the average mortality of the troops quartered in the same barracks for fifteen years past. The 63rd Regiment, with which they had exchanged, though not specially noted for intemperance, had there lost 73 men in the first nine months of the previous year, or at the annual rate of 78·8 per 1,000; and, having then marched to Madras to take the place of the 84th, had so many sick when the two regiments met on the road, as to be forced to borrow the 84th's dhoolies.

[1] The peculiar susceptibility of the nervous system of children often affords a most striking *test* of atmospheric impurity that might otherwise pass unheeded. In the last century, *trismus nascentium* (a disease now rarely seen) was one of the principal factors of the very high rate of infantile mortality which then prevailed. This disease continued to be very fatal in the Lying-in Hospitals of Dublin, after it had almost disappeared from those of London; and it was mainly by the attention to their ventilation enforced by Dr. Joseph Clarke,

PREGNANCY, Diseases and Disorders of. — Synon.: Fr. *Maladies et Troubles de la Grossesse*; Ger. *Krankheiten und Störungen der Schwangerschafts.*

Under this heading are included all those complaints which arise from the pregnant state, or which, occurring during gestation, are so modified, or exercise such an influence over it, as to require special treatment. The subjects of false pregnancy and concealed pregnancy will also be noticed. The principal conditions which demand consideration in this article are therefore the following: (1) Vomiting and other sympathetic or reflex disorders of early pregnancy; (2) Certain diseases specially liable to eventuate in abortion; (3) Ptyalism; (4) Displacements of the Gravid Uterus; (5) Embolism; (6) Extra-uterine Pregnancy; (7) Pruritus of the Pudendum; (8) Œdema of the Labia and Lower Extremities; (9) Œdema of the Upper Extremities; (10) Hæmorrhoids; (11) Dropsy of the Amnion; (12) Cramps; (13) Eclampsia; (14) False, and (15) Concealed Pregnancy. *See also* Fœtus, Diseases of.

The foregoing list of the principal diseases of pregnancy might be much extended if we were to include mastodynia and mastitis, jaundice, constipation, diarrhœa, cardialgia, headache, insomnia, palpitation and hypertrophy of the heart, rheumatism, inflammation of the uterus, pudendal hæmatocele, &c. To these and most other diseases pregnant women are liable; but not being peculiar to pregnancy, or essentially modified thereby, they require no notice in this place.

It would also be beyond the scope of this article to refer to all those anomalous sympathetic disturbances of the nervous system, such as longings, morbid or depraved appetite, hysterical excitability, nervous pains, odontalgia, &c., that sometimes attend gestation, and which, unless excessive, may be regarded as symptoms, and not included amongst the diseases of pregnancy.

1. Vomiting.—The most common complaint of early pregnancy is morning sickness, or nausea and retching, usually confined to the forenoon, and continuing from the third week after conception until the period of quickening.

The sickness of pregnancy is generally attended by no loss of appetite or impairment of health, and may thus be distinguished from vomiting caused by gastric or other diseases.

that the mortality of the infants born in them was reduced. The disease has continued to our own day, under precisely similar conditions, in St. Kilda, and some parts of Iceland, where *two-thirds* of all the children born have died in the first twelve days. Even in what would be accounted the well-ventilated dwellings of our own middle and higher classes, obstinate cases of spasmodic croup, recurring with the appearance of every tooth, are frequently seen, which immediately yield on the removal of the little patients to the pure air of the country or the seaside.

In some exceptional instances, however, this complaint assumes a graver aspect; continues throughout the whole term of gestation; harasses the patient by continual retching; and, as occurred in one case which came under the notice of the writer, may even cause death from exhaustion.

Ætiology.—Morning sickness has been referred by different authorities to fulness of the vessels of the uterus; to tension affecting the nerves of the uterus, especially those which arise from the sympathetici maximi and communicate with the plexus at the mouth of the stomach; to displacements of the uterus, and to the compression undergone by the uterine tissues, markedly by the nervous fibres at the seat of the flexion.

Treatment.—The treatment of this complaint depends on the period of pregnancy, the severity of the symptoms, and the constitution of the patient. In ordinary cases it may be prevented by the patient remaining in bed until the usual period for its return has passed over. Her diet should be light, and she should take as little fluid as possible, especially avoiding all warm drinks, such as tea. The bowels should be regulated by mild antacid aperients or effervescing salines. At the same time some of the so-called specifics may be ordered, such as oxalate of cerium, or salol in two-grain doses, or diluted hydrocyanic acid with infusion of calumba. It is unnecessary to refer at any length to all the remedies, too generally useless, which have been proposed for this complaint, including the dilatation of the cervix uteri, first suggested by Dubois; the hypodermic injection of morphine, chloral hydrate, carbolic acid, minute doses of ipecacuanha, and the topical application of a 4 per cent. solution of hydrochlorate of cocaine to the cervix uteri.

In some cases of excessive vomiting persisting during pregnancy and occurring in plethoric patients, six or eight ounces of blood may be taken away with advantage. If, notwithstanding this, the sickness continues, and the patient be in danger of dying from exhaustion, the propriety of inducing premature labour becomes a grave question. In no case should so serious a measure be resorted to without full deliberation and consultation. In all cases it should be deferred as long as possible, and in fixing the period for its performance regard should always be paid to the possible viability of the fœtus.

2. Diseases disposing to Abortion.—The expulsion of the fœtus before the ordinary period of viability may result from diseases or abnormalities affecting either the mother or the ovum. This subject is fully discussed in a separate article. *See* Miscarriage.

3. Ptyalism.—This is an occasional complaint of early pregnancy which seldom requires any treatment. In exceptionally severe cases, salivation may be controlled by

the application of tanno-glycerine and astringent gargles, especially chlorate of potassium in infusion of bark.

4. **Displacements of the Gravid Uterus.**—(*a*) *Retroversion.*—This form of displacement sometimes occurs in early pregnancy, from pressure of the enlarging womb on the neck of the bladder, which, thus prevented from completely emptying itself, becomes so distended that it gradually forces the fundus uteri downwards and backwards into the hollow of the sacrum, whilst the cervix is tilted upwards and forwards against or above the symphysis pubis. The symptoms of this occurrence are difficulty in passing water, or even complete retention of urine, with tenesmus and powerless straining to empty the bowels. At the same time a sense of weight, or fulness, and bearing-down pains in the pelvis are complained of.

Treatment.—The treatment of retroversion during pregnancy must be prompt, as, if it be complete, it not only occasions considerable suffering to the patient, but also certainly ends in the premature expulsion of the fœtus when not rectified. In cases of slight retroversion, the displacement may be remedied by emptying the distended bladder with the catheter, then replacing and subsequently supporting the uterus with either a Hodge's or other suitable pessary, and keeping the patient lying on her face for a few days. In complete retroversion this becomes a matter of considerable difficulty. The patient should be placed on her hands and knees; the bladder emptied; and the fundus pushed up from the rectum by a couple of fingers of one hand, whilst with the other hand the cervix is pulled down. A well-bent pessary should be passed up into the posterior *cul-de-sac* of the vagina, and the recumbent position maintained for some time.

(*b*) *Anteversion and Anteflexion.*—Anteversion and anteflexion, to such an extent at least as to give rise to any urgent symptoms and to call for active treatment, are very exceptional complaints during pregnancy. In such cases, however, the patient complains of bearing-down pelvic pains, and on examination the os uteri will be found in the posterior *cul-de-sac* of the vagina, looking towards the sacrum, the fundus uteri pressing on the neck of the bladder, and thus occasioning at first incontinence of urine, which, as the displacement increases, changes to difficulty in micturition or complete retention. In anteversion, abortion is said to occur at an earlier period than in retroversion.

Treatment.—The treatment consists in placing the patient on her back; mechanically reducing the displacement; and applying a suitable pessary.

5. **Embolism.**—We occasionally, though fortunately rarely, meet with cases of sudden death during pregnancy which cannot be accounted for by cardiac disease, aneurysm, or accident. In the pregnant state, the blood being overcharged with fibrin, a strong predisposition to the formation of a fibrinous clot or thrombus exists, and this is increased by any circumstance that depresses the circulation, such, for instance, as the fainting that frequently attends quickening. Thus a thrombus may be formed which, by becoming impacted in the pulmonary artery or elsewhere, at any subsequent period of gestation, may block the current of the circulation and so cause sudden death.

There are no symptoms by which a thrombus can be recognised, until its presence is discovered after death. Hence the only lesson we can learn from the history of such cases is the necessity of attention during gestation—firstly, to the diminution as far as possible, by dietetic and other means, of the existing hyperfibrination of the blood; and secondly, to the prevention during that period of the occurrence of any undue depression of the circulation.

6. **Extra-Uterine or Ectopic Gestation.**—The development of a fertilised ovum elsewhere than within the uterine cavity, albeit comparatively infrequent, is the most important of the pathological possibilities connected with pregnancy. The ovum may be diverted from, or arrested at any point of, its physiological course from the ovary to the uterus, and nevertheless maintain vitality and continue to grow in its abnormal situation, which in the great majority of such cases will be found in either of the Fallopian tubes. Besides tubal gestations, however, other forms of ectopic pregnancies are possible, and in rarer instances the situation of the misplaced ovum-cyst has been abdominal or intra-peritoneal, in others ovarian, and in others again its location has been tubo-uterine or interstitial.

Ætiology. — Until within the last few years little was known with any certainty on this subject. Judging from the general history of cases of this kind, ectopic pregnancy is as a rule consequent on previous puerperal or pelvic inflammation, by the extension of which to the Fallopian tubes their integrity, functional and structural, is impaired or destroyed. For, inasmuch as impregnation does not normally take place in either the ovary or the Fallopian tube, but within the uterus itself, its occurrence elsewhere is probably most generally due to denudation of that ciliated epithelium lining the tubes, the chief function of which under normal circumstances is to prevent the entrance therein of spermatozoa. 'If,' says Mr. Tait, 'there has been a destruction of the ciliated layer, which is not reproduced, then we have the possibility, in the first place, of a spermatozoon entering the tube, and, still more important pathologically and clinically, after impregnation, the ovum may

become attached to the walls of the tube as it normally is to the uterus.'

Symptoms and Diagnosis.—Ectopic gestation is liable to be confounded with the following conditions, namely—normal pregnancy, more especially when complicated by ovarian prolapse into Douglas's space; pelvic hæmatocele or abscess, uterine fibroid, or fibro-cystic tumours similarly situated; and retro-displacements of the gravid uterus before the fourth month. In the commencement of an ectopic gestation there is absolutely no possibility of discriminating between it and normal impregnation.

The diagnosis of this condition must in the first instance rest mainly on the clinical history of each case. Extra-uterine gestation seldom occurs in primiparæ, and most frequently happens in second or third pregnancies after a long interval of sterility. The ordinary symptoms of early pregnancy are then generally well marked, with possibly one exception, as menstruation may either be suppressed in these cases as in normal pregnancy, or else, and more usually, there may be periodic hæmorrhagic discharge *per vaginam.* But, almost from the commencement, the patient complains of some localised abdominal or pelvic pain, with occasional exacerbations of a severe colicky character, together with a distressing sense of fulness, soon traceable to a distinct and increasing tumefaction, generally retro-uterine, and discoverable on rectal examination. Under such circumstances, even at a comparatively early period, we may suspect ectopic gestation. This suspicion must now, if possible, be made a certainty, or disproved, by a carefully conducted conjoint recto-vaginal and bi-manual examination. In this way, without resorting to the use of the sound, which is contra-indicated and would be unjustifiable, the physical condition of the uterus, its appendages, and the surrounding parts, can be ascertained. If the pregnancy be tubal, although the uterus will generally in such cases be found hypertrophied and almost as large as in normal gestation, the os will be soft and patulous. Behind, or to either side of, the posterior uterine wall may be discovered in Douglas's space a well-defined globular, firm, elastic, or semi-fluid tumour, which if re-examined after a few days will be found to have rapidly developed in size; and which, if once felt, can hardly be confounded with anything else likely to be met with in that situation.

The consideration of the remarkable series of developmental changes by which the vitality of the erratic ovum may be maintained in these cases would be entirely beyond the scope of the present article. What chiefly concerns the practitioner is the ordinary course and result of an ectopic gestation. On this point it is sufficient to say that in the most frequent, namely, the tubal, form of extra-uterine pregnancy, the case, if left to its own course, will probably terminate at about the third month, or earlier, by the rupture of the distended tube. This accident is generally unmistakably evinced by sudden collapse, following intense pain in the Fallopian region, and will in most cases eventuate in speedy death from intra-peritoneal hæmorrhage. Should this not take place, however, we can confirm the diagnosis by vaginal examination, on which the firm elastic tumour previously existing in Douglas's space will commonly be found replaced by a soft boggy tumefaction filling the pelvic fossa, and pushing the uterus forwards and upwards. Such is the general course of such cases. To this general rule there are, however, several exceptions of great practical importance. In the first place, it is possible, though not probable, that the ectopic ovum-sac may remain unruptured for a sufficient time to admit of the development of a viable child therein. Secondly, when rupture of an early ectopic gestation-cyst occurs into the broad ligament, the consequent hæmorrhage may become arrested without any surgical interposition, the effusion in these exceptional cases being of no greater moment than an ordinary hæmatocele, and leaving the patient with as good a chance of recovery as in any other form of pelvic hæmatocele. Thirdly, the escaped fœtus may possibly maintain its vitality in a new extra-uterine situation, and be thence ultimately extracted by abdominal section. And, lastly, in many well-authenticated instances the undelivered fœtus has eventually become dried up or mummified, and thus retained for an indefinitely protracted period without giving rise to any very obvious symptoms of its presence.

Treatment.—Under this heading two entirely distinct questions must be considered. The first is, what course should be adopted when rupture of the sac has occurred, and when the patient, if left to nature, will probably die from intra-peritoneal hæmorrhage and shock. Under such circumstances there can be no room for hesitation in acting on the rule of practice which has been well formulated by Mr. Tait: 'Open the abdomen, go at once to the seat of the rupture—that is, the broad ligament—and tie it; for until you come to the ligament itself the tissue is always so rotten and friable that any attempt to arrest the bleeding in any other way cannot succeed. Then clear out the *débris* and put in a drainage-tube. Of course, amputation of the ligatured mass is a matter of necessity; nobody would ever dream of leaving such a thing to putrefy in the abdomen.'

We have, secondly, to consider in what way we can best deal with ectopic gestations which come under observation before rupture of the sac has taken place. These cases

cannot be so summarily disposed of. In their management we have three courses open to us. In the first place comes the arrest, or attempted arrest, of the development of the erratic ovum, either by the topical employment of electricity as a fœticide, or by the injection into the sac of morphine with the same intention, or by the draining off of the liquor amnii by aspiration or otherwise. These are each and all strenuously advocated by various authorities. Nevertheless, they are here mentioned merely to warn the practitioner against placing any reliance on their utility in such cases. The fœtus may possibly be destroyed by any one of them, but its destruction is by no means synonymous with the arrest of the ovuline tumour, since, as the writer has seen clinically exemplified, the placenta may not only retain its vitality, but even acquire an increased or monstrous developmental activity after the death of the embryo. By the second of the methods of procedure recently recommended in the treatment of this condition—namely, immediate surgical interposition, or resort to laparotomy and removal of the erratic ovum as soon as its misplacement is discoverable—the trouble may be effectually and possibly safely disposed of. But this practice is open to the objections, that it may not only be entirely needless, for, as the late Dr. Mathews Duncan said, 'in many cases no treatment whatever is required,' but also that it eliminates any possibility of preserving the life of the child, which is a factor never to be lost sight of in any obstetric difficulty. Thirdly, there remains the conservative and wiser policy of careful and watchful expectancy, with the view of prolonging the duration of the ectopic gestation, so far as may be compatible with the safety of the mother, until a period of viability can perhaps be reached, when the child may be extracted by the now comparatively safe and successful methods of modern abdominal surgery.

In this connexion it therefore becomes a matter of practical importance to determine at what period of early gestation can a living or possibly a viable child be extracted. In a case recorded by the writer, delivery took place at four and a half months, and the child, which weighed nine ounces, lived for an hour and twenty-five minutes after birth; another, born at the same period, survived for twenty minutes; another, delivered 195 days after last menstruation, lived six hours; two children delivered at the sixth month survived twelve and twenty-four hours respectively; and one born before completion of the seventh month lived for a considerable time, or at least until the writer lost sight of the patient after the puerperal period. These were, however, merely cases of live birth at an early period of fœtal existence; but many well-authenticated cases of viability under similar circumstances have also been recorded. Amongst such is that mentioned by Capuron, of Fertinio Liceti, who appears to have come into the world after a gestation of only four months and a half, and to have remained in it to the age of eighty. M. Devergnie cites the case of Cardinal Richelieu, who is asserted to have been born at the fifth month. In a well-known Scotch case, cited by Taylor and by Beck, it was decided that a child born in the sixth month after marriage, and which survived, was legitimate. Though such instances as the foregoing, the list of which might be easily extended, of viability before the seventh month can only be regarded as exceptional cases, their possibility is a fact that cannot be wholly overlooked in considering the period at which operative interference in cases of ectopic gestation is advisable.

7. **Pruritus of the Pudendum.**—Pruritus is occasionally a distressing result of the general hyperæsthesia and congestion of the generative organs during pregnancy, and consists in intense irritation, extending over the external orifice of the vagina, labia, and clitoris. The itching occurs in paroxysms which are most troublesome at night, and in aggravated cases wear out the patient, mentally and physically, from the loss of rest and constant irritation. In most cases this may be relieved by washing the parts with tar soap; giving an effervescing saline containing bromide of sodium in full doses, together with mild aperients; and the local application of boric acid or of a solution of hydrochlorate of cocaine, either separately or in combination with menthol or with peppermint water.

8. **Œdema of the Lower Extremities.** Œdema of the lower limbs, from the pressure of the gravid uterus on the veins, is a common complaint in the later months, and seldom requires any treatment beyond rest and aperients. Nor is the dropsical tumefaction of the labia, which occurs from the same cause, more serious.

9. **Œdema of the Face and Upper Extremities.**—This is always an alarming symptom during pregnancy, very frequently foretelling uræmic convulsions, and, if attended by albuminuria, urgently demands active treatment, such as depletion by cupping over the loins, and strong saline purgatives.

In all cases and forms of dropsy during pregnancy, the urine should be frequently tested for albumin; and if this be found, the case must be treated as one of impending convulsions.

10. **Hæmorrhoids.**—At all times women are more subject to this complaint than men; and during pregnancy, owing to the pressure of the gravid uterus on the hæmorrhoidal and iliac veins, comparatively few escape either internal or external piles. As Smellie observed, 'the same method of cure may be

administered as that practised at other times, though greater caution must be used.'

11. **Dropsy of the Amnion.**—This condition is met with in some cases of abortion from vesicular or other placental disease. It also occurs from simple over-secretion of the amniotic fluid, and is then chiefly of interest as the cause of a condition to which the older writers attached great importance, namely, pendulous belly. This was regarded by Devanter and other of the older writers as the ordinary source of obliquities of the uterus, and of difficult labour. Without discussing that question, we must regard this condition as of some importance, not only from the inconvenience it occasions, and which may be palliated by a well-fitting, supporting abdominal belt, such as every pregnant woman should wear, but still more from the probability of its leading to *post-partum* hæmorrhage, from inertia of the over-distended uterus. Hence in these cases it is necessary to deviate from the ordinary rule of midwifery practice, by rupturing the membranes, the presentation being natural, as early as possible during labour.

12. **Cramps.**—Cramps in the legs, from uterine pressure on the large nerve-trunks at the brim of the pelvis, are common during the last months of pregnancy, and generally come on at night in the course of the anterior crural nerve, extending down into the calves and feet. In ordinary cases no treatment is required, unless friction over the seat of pain, and some aperient, can be so called. Where, however, as sometimes happens, the cramps become unusually severe and frequent, their recurrence may be prevented by the pressure of a bandage or elastic stocking.

13. **Eclampsia.**—This is, with one exception, the most serious complication of gestation. The true convulsions of pregnancy are *sui generis* in their nature, though they are usually, but erroneously, classified as hysterical, epileptic, or apoplectiform.

Hysterical convulsions, being nothing more than a manifestation of hysteria, accidentally affecting a woman in the early months of pregnancy, require no special treatment, nor any further notice in this connexion.

The so-called epileptiform and apoplectiform convulsions of pregnancy are identical in their character, and are influenced in their symptoms by the constitutional state of the patient and the severity of the attack, rather than by any essential difference in the nature of the disease.

Symptoms.—The premonitory symptoms of convulsions are of considerable importance, as by their timely recognition, and the adoption of suitable treatment, the approaching attack may be often warded off. In the majority of cases, eclampsia is preceded by œdema of the upper extremities, face, and eyelids; pains in the lumbar region; albuminuria; and headache, vertigo, or peculiar irritability of temper.

In asthenic eclampsia, the clonic spasms commence with twitching of the muscles of the eyelids, soon increasing in violence; extend to every part of the body; and recur at irregular intervals. In anæmic patients, throughout the attack, the face may be cool and pale, the eye glistening, and the pupil contracted; but, generally, as the convulsions recur more frequently, the impeded respiration induces symptoms of venous congestion: the face becomes livid; the breathing stertorous; the pulse full and labouring; and thus the disease passes from the first into the second stage, or from the so-called 'epileptiform' into the so-called 'apoplectiform' convulsions.

In plethoric women, however, the complaint commonly assumes the apoplectic character from the first, setting in by a violent convulsion, immediately after which the patient falls into a comatose state, the convulsions meanwhile recurring at frequent but irregular intervals. After some time, under favourable circumstances, the convulsions cease, and the patient slowly regains consciousness. But, on the other hand, the coma may become more profound, the pulse more labouring, the respiration more embarrassed, and the extremities colder, until at length 'the last sad scene of all' is closed by a violent convulsion.

These convulsions, although they are more frequently observed in the latter months, may occur at any time of pregnancy, as well as during labour, and within the puerperal period.

Pathology.—The cause of eclampsia is a subject on which innumerable theories have at different times prevailed. It was formerly referred by some authorities to congestion of the brain; by others to uterine irritation acting upon the upper part of the spinal cord and medulla oblongata.

It was almost universally held up to a few years ago, and to the present time is still generally believed by a majority of obstetricians, that this disease is the result of uræmic blood-poisoning, probably consequent on nephritis, acute or chronic, for we find the convulsions of pregnancy frequently associated with dropsy, albuminuria, and a diminished excretion of urea and uric acid.

That convulsive action may be occasioned by uræmic blood-poisoning is well known in other conditions; and during pregnancy the same effect may also be produced by the pressure of the gravid uterus on the renal emulgent veins, interfering with the functions of the kidneys.

More recently, however, this view has been to some extent displaced by what is known as the 'Traube-Rosenstein theory,' the chief part of which is the assumption that the cause of puerperal convulsions consists in

cerebral anæmia, consequent on serous effusion disturbing the cerebral circulation, and resulting from increased arterial tension during pregnancy. Neither the general symptoms of puerperal convulsions, nor the results of the plan of treatment which he has found most effectual in the general treatment of the disease, would seem to the present writer to support this last-mentioned theory. Still, it is a fact that in some instances puerperal convulsions occur irrespectively of any renal disease, and without the existence of albuminuria.

The influence of mental and moral impressions in causing convulsions has been remarked by all obstetricians. The fact of its being the patient's first pregnancy has also some influence; thus, of eight cases that came under the writer's notice, five were primiparæ.

Treatment.—In the treatment of the convulsions of pregnancy, whenever any of the premonitory symptoms already described, and more especially albuminuria, are observed, we should direct our efforts to the depuration of the blood, by cupping over the kidneys, and the administration of mild diuretics, saline purgatives, diaphoretics, and a milk diet. At the same time we must endeavour to allay nervous irritability by sedatives, of which in these cases the best is bromide of potassium.

During the convulsions, precautions to prevent the patient from biting her tongue, or from injuring herself in any way, should in the first instance be taken. One of the most effectual means of shortening the paroxysms is cold affusion on the head and face. In the asthenic form of eclampsia, however, this remedy should be used cautiously. In all cases of well-marked puerperal convulsions the bowels should be unloaded by calomel and jalap, or by a drop of croton oil, or by the asafœtida enema; the head should be shaved and blistered, or ice applied, and at the same time sinapisms be put on the legs.

In cases of sthenic convulsions blood-letting is the only remedy of undoubted efficacy in subduing the convulsive action. If the patient be plethoric, and her pupils be contracted, we may, as a rule, bleed. If, on the contrary, the pupils be dilated, the condition of the brain may be considered as anæmic, and blood-letting would probably be out of the question. *See* Depletion.

The amount of blood that may be taken from a plethoric woman suffering from eclampsia should be measured by the patient's condition, and the effect produced, rather than by the quantity abstracted. In hysterical convulsions, if cold affusion does not suffice, the inhalation of chloroform or ether will generally cut short the attack. But in true puerperal convulsions it requires to be used with great caution, being contra-indicated whenever the circulation is depressed, or where there is any tendency to apoplectiform symptoms. In suitable cases, however, he has found chloroform serviceable in subduing the convulsions, and prolonging the intervals between them. Chloral hydrate, opium, and belladonna have also been used. As a substitute for blood-letting, the tincture of veratrum viride is employed by some American obstetricians. In the actual treatment of convulsions, time is, however, too important to be wasted in experimenting with these uncertain drugs; though in the prophylactic treatment of convulsions during pregnancy and after parturition, the writer has found small doses of belladonna beneficial in calming the nervous susceptibility so intimately connected with convulsive action.

In every case of convulsions towards the end of pregnancy, our primary object should be to deliver the patient as speedily as is consistent with her safety and that of her child.

14. **False Pregnancy.**—Synon.: Pseudocyesis.—This is a subject of considerable interest in an obstetric as well as a medico-legal aspect. Spurious pregnancy is of more frequent occurrence than is generally supposed; nor is it confined, as some writers assert, to sterile, hysterical, and dyspeptic elderly women of the upper classes.

Ætiology.—The great majority of cases are met with about the period of 'the turn of life,' or between the ages of forty-five and fifty. The causes of pseudocyesis, besides those before referred to, namely, change of life, dyspepsia, and hysteria, are very numerous, including ovarian disease, uterine tumours and physometra, abdominal plethora and obesity, molar pregnancy, and cystic disease of the ovum. Molar pregnancy generally terminates between the third and fourth months; but if continued beyond the latter period, the absence of the positive signs of pregnancy would show the true nature of the case.

Symptoms.—The symptoms of spurious pregnancy are occasionally so close an imitation of those of true gestation as to present great difficulties in their diagnosis. Most of the ordinary signs of pregnancy are simulated with extraordinary exactness in many cases of pseudocyesis. Thus we may have amenorrhœa, followed by irritable stomach; swelling of the mammæ; turgescence of the nipples; and rapid enlargement of the abdomen, concurring in a woman who wishes to become pregnant. In cases of pseudocyesis, the last of these symptoms may frequently be traced to an excessive deposit of fat in the omentum, or to the presence of some intra-peritoneal tumour. Moreover, it may also be caused by distension of the large intestines by accumulated fæces, or, more commonly, by flatus, constituting what the poor in Ireland graphically describe as 'a

windy dropsy;' or it may be due to dropsical effusion into the peritoneal cavity.

If to these symptoms be added, as is generally the case, some derangement of the patient's nervous system, we have the superstructure on which most cases of spurious pregnancy are built. As a rule, those who suffer from pseudocyesis either fear or wish to be pregnant.

Few cases are more difficult to deal with in practice than those now under consideration, and seldom is the obstetric physician more unpleasantly situated than when called in consultation to a patient who, having persuaded herself and those about her that she is pregnant, has made all the usual preparations for the expected event. Cases of this kind show the necessity for much caution in pronouncing any woman pregnant. If the physician disregard this caution, and unfortunately fall in with his patient's opinion, without sufficient examination in a case of pseudocyesis, as soon as the true state of the case becomes obvious, he will probably be made the scapegoat for that mistake, and suffer all the opprobrium of which a woman's wounded pride is capable.

Diagnosis.—The diagnosis of spurious pregnancy is always a matter of much difficulty during the first months of the disorder. But, however closely the early symptoms of pregnancy may be simulated, the positive signs of pregnancy after the fifth month cannot be counterfeited. And, even from the very first, in spurious pregnancy it may generally be ascertained, on careful inquiry, that there is something unusual in the symptoms—either some essential one is wanting, or else the symptoms which belong to one period of pregnancy manifest themselves at another, and commonly earlier, time than is natural.

The utility of auscultation as a certain means of diagnosis in these cases is, under some circumstances, doubtful. Even in the last month of gestation, the fact of the sounds of the fœtal heart and placental *souffle* not being distinguished on auscultation is no proof that the uterus may not contain a living child. Nor is the value of the positive evidence, derived from the sounds of the fœtal heart and placental *souffle*, as great as it is sometimes supposed to be. An experienced auscultator can with certainty pronounce on the existence of a living child *in utero* from the auscultatory signs present. But all medical practitioners are not experts in this special subject; and the writer has seen sufficient proof that, by those who form a diagnosis, in such cases, from the presence or absence of any one sign of pregnancy, opinions are sometimes pronounced in haste, which have to be repented at leisure.

A careful examination of the abdomen may, even at a very early period of gestation, enable us to ascertain if there be any uterine enlargement, although before the fifth month it will not enable us to distinguish between the enlargement caused by disease, and that occasioned by pregnancy. To do this, we must institute a vaginal exploration, to determine whether the conditions of the os and cervix uteri be what are usual at the corresponding period of pregnancy, and then, by conjoint or bi-manual examination, ascertain the exact condition of the uterus.

In cases of pseudocyesis where the patient, being anxious to be thought pregnant, contributes to the deception by making her abdominal muscles so tense and rigid that it becomes impossible to ascertain the size and position of the uterus, we may readily dissipate the phantom tumour, and overcome the action of the muscles, by the use of chloroform.

Treatment.—It is needless to add anything about the treatment of the cases we have been considering. Pseudocyesis is only an effect of certain morbid conditions, the recognition of which the writer has endeavoured to point out. The treatment of these causes will be found fully described in the articles on these several subjects.

15. Concealed Pregnancy.—Concealed pregnancy is a subject so closely allied to pseudocyesis, that a few words on it appear a suitable sequence to the foregoing observations. It becomes essential for every medical practitioner to be prepared to meet cases of concealed pregnancy and attempted abortion under various disguises, and thus be enabled to detect and frustrate such crimes. So often has the writer detected pregnancy in patients who applied for emmenagogues under the pretext of simple amenorrhœa, that he makes it a rule—especially in hospital practice, where the class of persons above referred to are more likely to be met with—not to administer any medicine of this kind until he has satisfied himself as to the true state of the case, though this should be done without any expression of a doubt that might be unfounded.

Thomas More Madden.

PREMONITORY (*præ*, before; and *moneo*, I warn).—This word is associated with symptoms which give an indication or warning of the advent or onset of certain diseases or seizures; for instance, rigors during the invasion of fever, and the various auræ preceding an epileptic fit.

PRESBYOPIA (πρέσβυς, an old man; and ὤψ, the eye).—Impairment of the power of accommodation of the eye, the result of progressive senile changes, in consequence of which the nearest point of distinct vision lies at more than nine inches from the eye. Distant vision may be perfect; but the eye, unaided by an appropriate convex lens, cannot see clearly objects less than nine or more inches from the eye. *See* Vision, Disorders of.

PRESSURE.—This is an important subject from several points of view, but it will only be practicable in the present article to discuss it briefly from a general aspect, without entering into details.

1. **Ætiology of Pressure.**—As one factor in the causation of various morbid conditions, pressure is not uncommonly of much consequence, and it may itself originate certain lesions.

The pressure often comes from without, of which the following illustrations afford sufficient examples. General pressure upon the chest and abdomen, preventing the movements of breathing, may lead to death from suffocation, to fractured ribs, or to other consequences. This sometimes happens, for instance, when a person is crushed in a crowd, or is buried in a fall of earth, although the head may be free. Hanging and strangulation are forms of violent pressure exercised on the windpipe and vessels in the neck. The pressure of clothing is often very injurious in connexion with the chest, especially that produced by tight stays or belts. This leads to contraction or distortion of the chest; interference with the functions of the lungs, heart, stomach, and other viscera; displacement and distortion of organs; or actual pulmonary disease. A familiar illustration of the effects of pressure is found in the development of corns and deformities of the feet, from wearing tight or badly fitting boots; and in the distortions of the feet artificially produced in Chinese women by means of systematic pressure applied in early life. In this connexion may also be mentioned the wearing of tight garters, or other forms of local constriction, which especially tend to interfere with the passage of the blood through the veins, and to develop varicose veins. Occupation may be the cause of pressure originating disease. Thus, prolonged sitting at various occupations has been supposed to set up sciatica. Direct compression upon any part of the body, by implements used in certain callings, may originate morbid conditions. For instance, pressure thus produced upon the sternum is liable to cause deformity of the chest; and when exercised upon the epigastrium, it has been supposed to account, in some instances, for the local development of cancer of the stomach. Lastly, prolonged pressure from lying in one position for a length of time not uncommonly causes localised inflammation, gangrene, and bed-sores, in persons suffering from low fevers, paralysis, emaciation, and other conditions. *See* ULCER and ULCERATION.

Pressure is often exerted by morbid conditions in the body itself, affecting other structures in their neighbourhood, and thus inducing secondarily various symptoms or lesions. It may be more or less diffused, as in the case of an effusion of fluid into a serous cavity; or concentrated upon a certain limited region or individual structure, as often happens with aneurysms and solid tumours. In this way movements are often interfered with; or more obvious effects may be produced, namely, displacement of organs and other structures; compression of tubes, canals, hollow organs, or vessels, which may lead to their complete closure; irritation and inflammation, which may end in suppuration, ulceration, or gangrene; or actual destruction or absorption of tissues. The phenomena induced will depend upon the seat of the cause of pressure, and the structures which it affects.

2. **Pressure in Diagnosis.**—Patients may be conscious of a local subjective feeling of pressure, as in the chest or epigastrium, which in some instances may be of a certain value in diagnosis; but such sensations must never be regarded as reliable. The objective effects of pressure are, however, often evident, and afford clinical signs of the greatest diagnostic value, as is frequently illustrated in cases of diseases of the chest and abdomen. Moreover, the practitioner can, by means of pressure with the fingers or hand, himself determine many points of essential significance in the investigation of numerous cases. Indeed, pressure is often an important part of palpation or manipulation, as employed in physical examination (*see* PHYSICAL EXAMINATION), and is especially useful in the following particulars: By this means we are able to determine the existence and degree of local tenderness or hyperæsthesia. Pressure also helps to reveal the presence of air or fluid in the subcutaneous cellular tissue. It is absolutely necessary for bringing out the feeling of fluctuation, degree of resistance, tension, and other sensations; while the effect of pressure in modifying certain physical conditions may be of great service in diagnosis, as is exemplified by the influence thus produced in many cases upon an accumulation of fæces in the intestines. Pressure upon arteries or veins is employed with the view of observing its effects upon the local circulation, upon particular vessels, or upon tumours and other morbid conditions; and, in the case of the arteries, to determine the compressibility and degree of tension of the pulse.

3. **Pressure in Treatment.**—In this connexion the first point to be noticed is the necessity of removing any source of external pressure which is causing mischief; and also of getting rid of internal pressure, if this is practicable. Pressure may, however, frequently be itself employed with advantage as a therapeutic agent. It may be thus used in a more or less diffused manner; or concentrated on a limited surface. It may be practised by the fingers or hand; by means of plasters, bandages, elastic supports, and similar appliances; or by special surgical

apparatus, such as the tourniquet, acupressure, the ligature, the clamp, or trusses of different forms. Pressure also constitutes one element in friction, shampooing, and massage.

As regards the objects for which pressure is employed, in the first place, it not uncommonly helps to relieve pain, which may be illustrated by the effects of manual pressure in subduing the pain of intestinal colic; the relief often afforded to certain forms of headache by applying a bandage or handkerchief tightly round the head; and the beneficial results following the fixing of more or less of one side of the chest, by means of strapping or other agents, in cases of early pleurisy, pleuritic adhesions, or pleurodynia. Local pressure may also cure certain forms of neuralgia. Again, direct compression is sometimes employed to check symptoms produced by reflex influence; thus, pressure over the ovary may put a stop to vomiting, spasmodic or convulsive movements, and other phenomena of a hysterical character. Another use of pressure is to arrest the process of inflammation, which is exemplified by the practice of strapping the testicle in the early stage of orchitis. In relation to this point, a very important object for which it is employed is to promote the absorption of morbid accumulations and products, whether originating from inflammation or other causes. Thus, it helps to get rid of air; of fluid effusions, inflammatory or dropsical; of fibrinous exudations; and of thickenings or indurations resulting from acute or chronic inflammation. Pressure is again frequently taken advantage of for its influence upon the blood-vessels. Thus it checks different forms of hæmorrhage, the kind of compression required varying with the precise form of bleeding. Elastic pressure, according to Esmarch's method, has been found of great service in preventing bleeding during operations. In connexion with arteries, direct compression is also often employed for the cure of aneurysms. As regards the veins, pressure is of essential service in preventing the injurious consequences likely to result from varicose dilatation of these vessels, and in giving them support; while it is also made use of in the cure of varicose veins, especially in connexion with certain operative procedures. In the case of the abdomen, diffused pressure or support by means of a suitable bandage or other apparatus is often of much service to counteract the ill-effects of relaxed and flabby walls. Direct pressure may also be used to excite contraction of the intestines, bladder, or uterus, under certain circumstances; and to aid in the removal of accumulations in the bowels. Lastly, pressure is made use of in preventing certain forms of displacement of organs and structures, and in attempting to cure the conditions upon which they depend, as is exemplified by the application of a truss in cases of hernia, and by some of the operations for the radical cure of this complaint.

Frederick T. Roberts.

PRETORIA, in the Transvaal.—*See* Africa, South.

PREVENTION OF DISEASE.—*See* Personal Health; and Public Health.

PRIAPISM.—Synon.: Fr. *Priapisme*; Ger. *Priapismus*; *Ruthenkrampf.*

Definition.—A term generally understood to signify unduly occurring or unnaturally prolonged erection of the penis, accompanied or not, as the case may be, by inordinate sexual desire, and by more or less pain and physical and mental distress.

It is important to distinguish between mere turgescence of the organ—*false* priapism; and *true* priapism, or perfect erection. The former depends simply upon distension by blood, induced or permitted by relaxation of the walls of the blood-vessels and blood-spaces; it may be associated with comparative flaccidity, and, though uncomfortable, is rarely painful. The latter requires for its production, not only distension by blood, but a certain kind and degree of tension or contraction of the intrinsic muscular fibres of the trabeculæ and sheaths; it is characterised by manifest rigidity, and if long continued—as it may be for several days or even longer—usually gives rise to considerable suffering.

Description and Causes.—Priapism, more or less pronounced, from time to time occurs in connexion with various morbid affections of the general system, or of particular organs. Thus it usually, though not invariably, attends erotic mental derangement. It occurs frequently in tetanus and hydrophobia; and sometimes, occasionally even to a distressing extent, during recovery from the eruptive fevers, and in gouty and diabetic subjects. It has been noted in some cases of tumour or other disease of the cerebellum and pons Varolii; and in the earlier stages, or among the first indications, of certain diseases of the spinal cord, leading on to paraplegia. An overloaded condition of the lower bowel, especially in conjunction with enlarged and irritable prostate, inflamed hæmorrhoids, distension of the bladder, stone in the bladder, phimosis, urethritis, and other conditions, may be enumerated as not infrequent local causes of troublesome, though transient, priapism, acting either by pressure on the blood-vessels, or by reflex nervous influence. It also occurs among the results of injuries of the central nervous system, as well as of the penis itself. Injuries of the spinal cord, especially in the cervical and lumbar regions, are liable to be followed by continued or recurrent priapism, or by turgescence with.

flaccidity. Sudden erection, with emission, not infrequently attends injury of the cervical spine. Numerous cases are on record in which, during violent coitus, or otherwise during erection, the penis itself has undergone injury; and some portions or other of the sheaths of the corpora cavernosa, with the included blood-vessels, have been ruptured, or some blood-vessels have been ruptured, the sheaths remaining entire. In such cases extravasation of blood, followed by turgescence of the corpora cavernosa, may occur; and sooner or later the most persistent, and often very painful, priapism ensues. Thus it would appear that no one definite cause or explanation of the occurrence of priapism can be specified. Indeed, the subject has not hitherto been well worked out.

Treatment.—The treatment generally must depend upon the due recognition and treatment of the condition on which the priapism depends. If of central origin, it is to this point that attention must be directed. But it not infrequently happens that the local suffering is so considerable as to demand special measures for its relief. In some cases cold applications, in others warm or hot fomentations with anodynes, have proved most efficacious. Leeching has rarely been useful. Bandaging, masturbation, and sexual congress have often been tried; but the result, as a rule, has been to increase rather than to mitigate the evil. In cases in which extravasation of blood following injury is the cause, it may be necessary to make incisions, turn out any clots, and arrest further hæmorrhage; but permanent damage to the organ usually results, sometimes after prolonged suppuration, and sometimes even after risk to life.

In some cases the administration of iodide of potassium, in others of bromide of potassium in large doses, in others again the inunction of mercurial ointment, have been followed by successful results.

Among other medicines that have seemed more or less useful in various cases may be especially mentioned chloral hydrate, lupulin, camphor, hyoscyamus, and belladonna. Opium has often exacerbated the trouble. Free purgation is beneficial in most cases.

Arthur E. Durham.

PRICKLY HEAT.—An eruption of minute pimples, which cover the skin more or less extensively, and are attended with burning heat, and a most tormenting prickly itching. The affection occurs for the most part in hot climates, and attacks principally those who are unaccustomed to extreme heat; hence it is often experienced by travellers in tropical regions. Pathologically it is an eruption attended with great irritability of the skin, and has received the designation of *lichen tropicus* from its dependence on heat of climate. See Lichen.

PRIMARY (*primus*, the first).—This word is either used to imply that a disease originates in an organ or structure from a local cause, such as *primary pleurisy* or *peritonitis*, or *primary attacks*; or it is associated with the first manifestation of a disease, such as the *primary sore* of syphilis, or *primary cancer*. It is also applied to the *direct* or *immediate* symptoms of a disease, as distinguished from those which may be produced *secondarily* or *remotely*.

PROCIDENTIA (*pro*, downwards; and *cado*, I fall).—A falling down of certain organs or structures from their natural position, as of the uterus, rectum, or iris. See Prolapsus.

PROCTITIS (πρωκτός, the anus).—Inflammation of the anus or rectum. See Periproctitis; and Rectum, Diseases of.

PRODROMATA (πρό, before; and δρόμος, a course).—A synonym for premonitory symptoms. See Premonitory.

PROGNOSIS. — See Disease, Prognosis of.

PROGRESSIVE MUSCULAR ATROPHY. — Synon.: Chronic Spinal Muscular Atrophy; Wasting Palsy; Amyotrophic Lateral Sclerosis; Chronic Poliomyelitis; Fr. *Atrophie Musculaire Graisseuse progressive* (Duchenne); Ger. *Muskelatrophie*; *Muskellähmung*.

Description.—Progressive muscular atrophy is characterised by slow wasting of the muscles, beginning in some particular part, usually spreading and increasing, until it is wide in extent and extreme in degree. The changes in the muscles depend upon a slow degeneration in the ganglion-cells of the anterior cornua of the spinal cord, accompanied by a degeneration in the motor nerve-fibres arising from the cells. With this degeneration of the cells and peripheral fibres there is usually also associated a similar change in the pyramidal tracts of the cord, sometimes, at least, to be traced up to the motor cortex of the brain.

Charcot has divided cases of this disease into two varieties, the so-called 'protopathic' form, in which the affection consists essentially of a primary degeneration of the motor cells of the cord, the nerve-fibres proceeding from them and the muscles; and the 'deuteropathic,' in which there is also degeneration in the pyramidal tracts, to which the affection of the spinal cells was thought to be secondary. To this second class he gave the name 'amyotrophic lateral sclerosis,' but the distinction is not valid. The pyramidal fibres always degenerate with the motor cells and at the same time. The two varieties are essentially the same disease.

Ætiology.—Males are more frequently

attacked than females in the proportion of about three to one. The disease is one of adult life, commencing as a rule between the ages of twenty-five and forty-five. Cases have been recorded in which the affection commenced as early as twelve and as late as seventy, but most juvenile atrophies are primarily muscular. An inherited neuropathic disposition is to be recognised in a small proportion of cases, but direct inheritance of the disease is very rare. All classes of society are affected, and it is doubtful whether workers with the muscles suffer with greater frequency than is accounted for by their greater exposure to certain exciting causes. Of these, one of the most important is mental distress and anxiety, an influence especially potent in females late in life. A mental shock, such as that produced by a fright, has sometimes seemed to excite it. Another distinct cause is exposure to wet and cold, which is a cause of so many chronic spinal diseases. Sometimes the exposure has been habitual; sometimes there has been a single severe exposure, immediately succeeded by neuralgic pain, either in the part which subsequently wastes, or in other regions, indicative of the deleterious influence exerted on the nervous system. Excessive use of individual muscles may cause slight wasting; it is doubtful, however, whether this influence produces general muscular atrophy. Injury to the cord is a rare cause. The commoner sequel to such an accident is disseminated myelitis, which may be manifested by muscular wasting combined with other symptoms. In a few cases, concussion has been slowly followed by typical progressive muscular atrophy, as if some perversion of the nutrition of the nerve-elements had been produced by the accident. More rarely a fall, in which a limb has been injured, has been followed by muscular atrophy commencing in that limb. Syphilis is an occasional antecedent, and no other cause may be traceable. That syphilis is not without influence in the causation of such cases is probable from its relation to other diseases, as tabes. Occasionally syphilis and neurotic heredity can both be traced. In the cases in which atrophy has followed an acute specific disease such as measles, the malady is probably a chronic neuritis. Such cases are often of the 'peroneal type,' so called from the muscles in which wasting commences. Lead poisoning may produce chronic muscular atrophy, as well as the common acute paralysis with rapid wasting. It closely resembles the ordinary form of progressive muscular atrophy in seat and features, thus differing from the acute extensor palsy. In many cases no cause for the disease can be discovered.

Anatomical Characters.—The muscles are reduced in size and pale in colour. Parts may be hardly distinguishable from adjacent fat. On the other hand, the muscle may be dark as a whole, and pale streaks in it may mark the position of local degeneration. There are four well-defined microscopic changes in the fibres: (1) Simple narrowing, with little or no change in the striation. The striæ may appear to be farther apart than normal, and sometimes the fibrillary segmentation is unusually distinct. (2) Simple fatty degeneration, the transverse striation giving place to a granular appearance. The granules become larger and fewer, and ultimately distinct globules are seen scattered through the sheath. (3) So-called 'vitreous degeneration,' probably a distinct process from fatty degeneration. The sheath, in such a condition, contains only a clear material enclosing a few fatty globules and a few faint transverse striæ. (4) A longitudinal striation develops in the fibre, with which at first the transverse striation co-exists. As the latter becomes more and more faint, the fibre comes to have the appearance of a fasciculus of longitudinal connective-tissue fibres. Sometimes with this longitudinal striation the fibre presents a transverse striation much finer than normal. This change may sometimes be present alone. Fatty globules may accumulate between the fibres, with, in some cases, granules and masses of reddish-brown pigment. The nuclei are often increased, and sometimes the fibres of the interstitial tissue. The capillaries may be dilated and distended. Muscular fibres, practically unaltered, may often be seen side by side with others profoundly changed. The sheaths finally become empty and shrink, and may be scarcely distinguishable from the interstitial fibrous tissue.

There are many degenerated fibres in the peripheral nerves, conspicuous in the terminal branches to the muscles. These degenerated fibres can be traced to the anterior roots, which are diminished in size. The amount of degeneration in them corresponds to the wasting present in the muscles. The posterior roots are unaltered. The spinal cord is often softer than natural at the affected part, and the white substance of the lateral columns is grey and translucent. With the microscope the anterior cornua are seen to be much changed at the level at which the nerves to the muscles most affected are given off. Most of the large cells have disappeared, or are represented by small angular bodies. Frequently a few large cells can still be seen, but most of these have lost their processes, and are more globular than normal. The interstitial tissue is also increased.

There is distinct degeneration in the anterior root-fibres passing from the cornu through the anterior column. A few fibres may remain, but whole fasciculi appear to be replaced by fibrous tissue. There is also degeneration of fibres in the anterior commissure.

In the white columns there is usually considerable, often almost complete, degeneration of the pyramidal tracts, anterior and lateral, and the resulting sclerosis extends, in slight degree, beyond their limits. The degeneration can often be traced up through the decussation and through the medulla oblongata, and even through the pons and crus to the internal capsule. By the products of degeneration it can sometimes be traced through the white substance to the cortex. But it has also been found to cease at the crus or at the decussation.

In cases in which bulbar symptoms have been present the motor nuclei in the medulla have shown changes similar to those present in the grey matter of the cord. In other cases the changes in the nuclei have been slight; but in such cases the degeneration of the pyramids has been extreme, and no doubt involved the fibres connecting those nuclei with the cortex. The sympathetic nerves and ganglia, when examined, have shown no considerable alteration.

SYMPTOMS.—Wasting and weakness usually come on together; but in covered parts, such as the shoulder, the loss of power is frequently noticed before the wasting has been apparent. In the hand, not infrequently impairment of the power to carry out some fine action, such as writing, draws attention to the wasting.

The disease commences in the upper limb in nine-tenths of the cases, and almost as often in one arm as in the other, and in the hand as in the shoulder muscle. From the part first affected it spreads to the other muscles of the limb. In the hand, the thenar muscles and interossei are usually the first to suffer, and of the latter the abductor indicis is usually most conspicuously affected. Occasionally the disease begins in the forearm, especially in the extensor muscles; the ulnar extensors suffer most. Of the shoulder muscles, the deltoid is generally the first to waste; the supra- and infra-spinati are often affected with it; and the triceps usually suffers less and later than the biceps.

The muscles of the back are in most cases early involved in the wasting. The middle and lower parts of the trapezius suffer first, the rhomboids and erectors of the spine later. The serratus, latissimus, and pectoralis major are subsequently involved, but they may escape wholly or in part. According to the affection of the muscles connected with the scapula, the position of the bone changes. The highest part of the trapezius shows sometimes (but not always) a remarkable indisposition to waste, and it was hence termed by Duchenne the *ultimum moriens*. The muscles that extend the head on the spine often suffer in considerable degree, and a difficulty in the carriage and movement of the head is the result. The increased efforts of the weak extensors to balance the head on the spine, under such conditions, often cause a synergic over-action of the frontales which are habitually associated in action with the extensors. The skin at the back of the neck lies in transverse folds when the head is put back, which the patient may be unable, as he lies in bed, to move from side to side. In striking contrast to the wasting of the neck is the condition of the platysma, which always escapes, and not uncommonly undergoes hypertrophy as if in an attempt at compensation. The muscles of respiration suffer in the majority of cases, constituting a grave source of danger to life. The intercostals rarely escape altogether, and the diaphragm is involved in many cases. The muscles of the abdominal wall occasionally waste, but far less frequently than those of the thorax.

Wasting in the legs is much less common than in the arms, and if it occurs is usually slighter in degree; but occasionally the disease first manifests itself in the legs, and is more intense there than elsewhere. The face almost always escapes the general atrophy, and its normal appearance may present a striking contrast to the rest of the body. In many cases the lips and tongue are paralysed as part of the bulbar palsy which so often accompanies the spinal disease.

As the wasting progresses, hollows and prominences, usually invisible, become manifest, and various contractions and deformities occur as a result of the unequal affection of antagonistic muscles. In the hand the usual deformity is that of the 'claw-hand,' a result of paralysis of interossei, with unantagonised action of their opponents. Lordosis is common when the trunk and thigh muscles are involved.

The electrical irritability of the affected muscles varies in character. The rule is that, in a slowly progressive case, there is diminution in the readiness and degree of response to each current, a diminution which goes on *pari passu* with the wasting, until finally, when the wasting is extreme, it becomes extinct. But the voltaic irritability of the muscular fibres very often persists long after it is impossible to elicit any response to faradism, which acts only on the nerve-fibres. Although the quality of the voltaic irritability is usually normal, the qualitative change of the 'reaction of degeneration' without the quantitative may be present, A.C.C. being evoked more readily than C.C.C. When there is very rapid and considerable paralysis a typical reaction of degeneration may be present, and between these extreme forms various intermediate conditions may be met with.

The mechanical irritability of the muscles is considerably increased, and the spontaneous flickering—the so-called 'fibrillary twitching'—in the muscles is frequent, but not invariable. It is not uncommonly observed in

muscles not yet wasted, but in which atrophy subsequently occurs.

The myotatic irritability in cases in which there is 'atonic atrophy,' the muscles being flaccid and toneless, is lost, and lost early. But where there is rigidity from the first (otherwise described as 'tonic atrophy'), even when the wasting is considerable, the myotatic irritability is preserved and sometimes increased.

Beyond the vague pains already referred to, which sometimes occur in the region in which wasting of the muscles is soon after perceived, there are no sensory symptoms. 'Numbness' and 'deadness' may be occasionally complained of, but cutaneous sensibility is never impaired, nor do the muscles ever lose their sensibility.

The functions of the sympathetic are not, as a rule, impaired. Dilatation or contraction of one pupil has been observed, chiefly in connexion with atrophy of muscles that are supplied from the lower part of the cervical region. The reflex action of the iris is usually normal, and optic nerve-atrophy never occurs. Nystagmus is rare.

The visceral functions are usually little disturbed. Sexual power, indeed, is often lost, but the sphincters rarely suffer, even when the wasting is extreme. Slight, but inconstant, changes have been found in the urine. Glycosuria has been associated with bulbar symptoms, but only in a few instances.

Course and Complications. — In most cases the malady is steadily progressive, but the rate at which it advances varies much. It may, however, become stationary; unfortunately the period at which this most frequently happens is in the later stages of the disease, when little but life remains. Sometimes progress ceases at an earlier stage, least rarely in the cases in which the atrophy is strictly symmetrical. When its course at the commencement of the wasting is rapid, it usually continues rapid until it has attained a wide extent. When it begins slowly, it continues slow throughout, save for the occasional acute paralysis of some particular group of muscles. Such local loss of power may come on in a few days. The extensors of the wrist and fingers are the muscles most commonly affected in this way. When there is weakness of the legs without wasting, the onset of this may coincide with the atrophy of the arms, or may succeed it at any interval. It is rare for the weakness in the legs to occur first.

The most frequent complication of progressive muscular atrophy is bulbar paralysis, the result of a degeneration of the cells of the bulbar nuclei similar to that of those in the spinal cord. In rare cases muscular atrophy in the arms is accompanied by the symptoms of locomotor ataxy in the legs; and general paralysis of the insane has been met with as an exceptional complication. Severe and frequent headaches are occasionally present throughout the course of the disease.

The chief danger to life is from pulmonary disease, induced by the entrance of particles of food into the lungs, or by exposure to cold, and rendered grave by the weakness of the muscles of respiration. Bulbar paralysis also is a frequent cause of death, either by its interference with swallowing and nutrition, or through laryngeal paralysis. Less commonly, death results from bedsores and septicæmia, or from intercurrent maladies.

Pathology.—The constancy of the association of changes in the motor cells of the spinal cord, degeneration of the motor root-fibres, and wasting of the muscles, together with the analogous effects of focal lesions of the anterior cornua, leave no doubt of the relation of the muscular wasting to the disease of the cells and of the fibres proceeding from them. The condition of electrical excitability, its slow failure as nerve and muscle degenerate together, is explained by the slowness of the change in the nerves, permitting a similar rate of degeneration in the muscle. It is only when the usual slow process is varied by a more acute change in the cells and fibres, that the muscular tissue is for some time less damaged than the nerve-structures, and so presents paralysis in excess of wasting, and voltaic irritability in excess of faradic. Thus a slow decay of the lower segment of the motor path is the essential lesion in this disease, to which the conspicuous symptom is merely secondary. But the disease is rarely limited to the lower segment of the motor path. The pyramidal tracts, as already stated, are commonly degenerated, and it is probable that the degeneration often extends through their entire extent and involves the motor cells of the cortex. There may be no symptoms to suggest such a condition. The degeneration of the lower segment has usually caused atonic atrophy of the muscles, so as to produce the loss of all reflex action and mask the excess of myotatic irritability which degeneration of the upper segment would produce. The relation of these degenerations in the upper and lower segment to each other has been much discussed. Considering the very common occurrence in other conditions of an affection of one of these segments without any involvement of the other, one cannot be regarded as a result of the other, and hence the only adequate explanation of the facts is that the degeneration of the upper and lower segments is simultaneous, or, if not simultaneous, at least so far independent that neither is the cause or consequence of the other, both being the result of the same tendency to degeneration in the elements of the motor path.

It can be easily understood that the relative degree in which the two segments are affected may vary, and that such variations must give rise to numerous varieties of the disease. Thus weakness of the legs, with excessive myotatic irritability, often going on to spasm, is explained by the degeneration of the pyramidal fibres for the lower limbs, while the part of the lower segment related to these remains unaffected. The weakness of the legs usually succeeds the wasting in the arms. In most cases in which spastic paraplegia is followed by wasting in the arms, the latter have not shared the spastic palsy. When this condition is associated with slight wasting of the legs, without considerable change in electrical irritability, the condition exists in which we must assume that the motor cells of the cord, while structurally intact, undergo slight changes in nutrition. These are so slight as to cause no alteration in aspect, or at least so trifling a change that we are as yet unable to detect it. They are perhaps the result of degeneration in the termination of the pyramidal fibres. When such degeneration is secondary to a focal lesion of the cord or brain, its effect is not usually sufficient to arrest the myotatic irritability or to cause wasting such as attends the destruction of these cells.

But in some cases the muscular wasting may be great, although the increase of myotatic irritability persists. The condition then is one of 'tonic atrophy.' In those cases it is common to find that many nerve-cells have disappeared or are very small, while others remain normal or slightly changed in aspect. We have then apparently, in addition to the degeneration of the upper segment and the nutritional changes mentioned, a considerable degeneration of many, but not destruction of all, the elements of the lower segment. This cannot be regarded as simply secondary to the degeneration of the upper segment. It must be the expression of a distinct pathological tendency similar to that which elsewhere causes the atonic atrophy and total wasting, but insufficient to prevent the less affected cells from causing rigidity under the influence of the degeneration of the upper segment. It is doubtful whether the tonic atrophy ever goes on to atonic atrophy. If the result ever occurs, it is extremely rare. Nor does it seem that atonic atrophy ever gives place to tonic atrophy with excessive myotatic irritability. The rigidity which is the effect of degeneration of the upper segment is not produced if the lower is already so much changed as to abolish myotatic irritability. And yet the pyramidal tracts are constantly found degenerated, although the muscles have been flaccid to the last. In the rare cases in which muscles with atonic atrophy become rigid towards the end of the process, this is probably the result of changes in the muscles themselves, and is not dependent upon the central nervous system.

Diagnosis.—The diagnosis of the developed disease is simple. Doubt is only likely to arise in the early stages and when limitation to the one group of muscles raises the question whether the origin of the wasting is local or central. Such local atrophy is generally the result of an affection of peripheral nerves; and paralysis due to disease of a single nerve, or a plexus, will usually be recognised by its limitation. The distinction of some forms of multiple neuritis is much more difficult. This is especially the case when there has been a subacute onset, such as is common in neuritis, and this difficulty is increased by the fact that neuritis may affect only motor branches, as in lead palsy. But the subsequent slow wasting of other parts will render the character of the spinal disease evident; while in the peripheral affection a careful search will usually reveal other evidence of neuritis, as well as an obvious cause. In cervical pachymeningitis the association of sensory symptoms is distinctive, and the same applies to tumours of nerve-roots. Disseminated myelitis may cause widespread muscular atrophy, but symptoms of irregular damage to other than motor parts of the cord are also present. In syringomyelia, atrophy may occur indistinguishable from that in the disease now under consideration, but a careful examination will reveal the peculiar disturbance of sensibility, the loss to pain without loss to touch, characteristic of this condition.

The distinction from idiopathic muscular atrophy, especially when this begins late in life, is sometimes difficult. This is only true of the cases where no pseudo-hypertrophy is present. The characteristic distribution of the wasting, especially its commencement in the legs, its very slow course, and the tendency to affect other members of the same family, will usually distinguish this condition. Whenever several cases of muscular atrophy occur in the same family, or atrophy begin during childhood or youth, the probability is great that the affection is idiopathic and not spinal.

Prognosis.—The nature of the disease renders the prognosis in every case grave and uncertain. The chief factors in forming an opinion are the observed progress of the disease, and the energy which it has manifested. The possibility of arrest is greater in middle life than in advanced age. It also seems to be greater in cases in which the wasting is symmetrical than in those in which the two sides are irregularly affected. Spontaneous cessation rarely tends to take place until an advanced stage is reached, but arrest by treatment may take place at any period. Bulbar symptoms increase the gravity of the prognosis; and weakness of

the respiratory muscles, especially combined with an affection of the medulla, constitutes a grave danger to life. If the malady ceases to advance, there may be a certain amount of recovery of power, especially if the loss has been rapid and recent. Wasting that has existed for six months will probably remain unchanged. In a typical chronic case there is little hope of any actual recovery of tissue or power, as these depend upon destruction of nerve-elements which do not seem to be restored.

TREATMENT.—Favourable conditions of life—fresh air, gentle exercise, the absence of mental strain—are essential. Only one method of treatment has seemed to the writer to be certainly capable of arresting the disease, and that is the hypodermic injection of strychnine. In seven almost consecutive cases in middle life, this treatment has been followed by arrest within a month of its commencement, and the arrest has been permanent in all the cases but one. In senile cases the treatment has failed. Administration of the drug by the mouth has not the same effect, and failure by the mouth does not lessen the prospect of good from its subcutaneous use. It may be that the drug, administered hypodermically, is brought more rapidly in contact with the nerve-elements, and acts on their nutrition with a relatively greater momentum. It is best to give one injection daily, at any convenient place. The most convenient salt is the nitrate, and the dose should be $\frac{1}{100}$ of a grain increased to $\frac{1}{40}$. When arrest seems to have taken place, it is well to intermit the injections for one week in three or four. Other nervine tonics may be given by the mouth at the same time. In a malady so grave it is desirable to neglect nothing that may have a beneficial influence.

Local treatment has not much effect on the wasting. Electricity and massage are of service in stimulating the circulation and muscles, and the latter measure is useful in preventing contractures. The constant current is that which is in general of most service, but faradism may be used if the muscles respond to a strength of current which is not painful.

No special bath treatment is of service, and antisyphilitic treatment invariably fails. In some cases it seems to accelerate, and the writer has known it apparently to cause the disease. All treatment should be pursued in moderation, and its effects carefully watched.

W. R. GOWERS.

PROGRESSIVE MUSCULAR DYSTROPHY.—SYNON.: Idiopathic Muscular Atrophy; Myopathic Atrophy.

DEFINITION.—A primary disease of muscles not depending on morbid changes in the spinal cord.

Two forms are recognised—(1) the *pseudo-hypertrophic* form; (2) the *simple atrophic* form.

1. Pseudo-Hypertrophic Muscular Paralysis.—SYNON.: *Atrophia musculorum progressiva myopathica*; Fr. *Paralysie pseudo-hypertrophique*; Ger. *Myopathische progressive Muskelatrophie.*

DEFINITION.—A progressive muscular paralysis, appearing mostly in boys, in which the ultimate fibres of the affected muscles atrophy, but many of the muscles themselves appear to be hypertrophied, in consequence of the development of interstitial fat and fibrous tissue.

ÆTIOLOGY.—Pseudo-hypertrophic muscular paralysis is a disease of boys, few cases having been observed in girls or in adults. In a large number of cases it begins in infancy, the weakness becoming manifest at the time the child should begin to walk. In some instances it has been found to be hereditary, several children in the same family having been affected. Nothing definite is known as to the direct causation of the malady.

ANATOMICAL CHARACTERS.—In the earlier stages of the disease, the muscles chiefly affected are those of the legs and lower part of the back, particularly the gastrocnemii, the posterior muscles of the thigh, and the erectores spinæ. These muscles are enlarged, and they are felt to be firm and hard. This is not, however, due to true hypertrophy, for if a portion of the muscle be removed during life by the *emporte-pièce* or harpoon, an instrument constructed by Duchenne for this purpose, the muscular fibres are found to be atrophied, and much of the apparent bulk is seen to be due to an interstitial development of fat and fibrous tissue. Subsequently, the remaining muscles of the trunk, upper limbs, and sometimes even of the face, become similarly affected, in most cases these muscles merely wasting without any apparent enlargement, but in other cases the apparent hypertrophy being present in the upper as well as the lower half of the body. In the later stages of the disease, the whole of the voluntary muscles, including those which at first were enlarged, become more or less wasted. The diseased muscles are found after death to be composed in a great measure of ordinary fat-cells. The true muscular substance has to a considerable extent disappeared, and only a few ultimate muscular fibres are seen running at intervals through the fat. Some of these ultimate fibres retain their normal size and appearance; others are much decreased in size, though still showing the striation—only a few of the atrophied fibres have lost their striation, and become granular. The diseased muscles also contain a considerable quantity of fibrous tissue, some of which is probably the remaining sheaths of muscular fibres which have undergone

complete atrophy. There is less fat and fibrous tissue in the wasted muscles than in those which are pseudo-hypertrophic, but the changes in the ultimate muscular fibres are the same in both.

The spinal cord and the motor and sensory nerves exhibit no morbid changes. In one case, however, Lockhart Clarke and Gowers discovered marked alterations in the spinal cord, the principal change being extensive disintegration of the grey matter at the centre of each lateral half of the cord, and of the anterior commissure.

Symptoms. — The symptoms of a well-marked case of pseudo-hypertrophic muscular paralysis are very striking, and cannot easily be overlooked or mistaken. When the child is stripped, the muscles of the calves are seen to be larger and firmer than natural, and the same apparent hypertrophy may be present in the muscles of the thigh, the glutei, the lumbar muscles, and others. Occasionally the muscles of the upper half of the body exhibit a similar increase in size, especially the infra-spinati, but much more frequently they are wasted, so that the emaciation of the upper half of the body contrasts strongly with the apparent excess of muscular development in the lower half. The next most obvious symptom is protuberance of the belly. There is no abdominal enlargement, but the antero-posterior curvature of the vertebral column in the lumbar region is much exaggerated, and the shoulders are thrown back. This unnatural curve is not caused by any disease of the vertebræ, for it entirely disappears when the patient sits or lies down. When the child stands, the legs are held apart, and the heels raised off the ground. He walks almost on tiptoe, as in talipes equinus, and with a most peculiar gait—a waddle, as if he needed to balance the body first on the one leg and then on the other. Walking soon tires him. If he attempts to go fast he falls, and he is very easily knocked over. He can readily stoop so as to touch the floor, but generally has great difficulty in raising himself to the erect posture, using powerful muscular effort, and having to assist the movement by means of the hands placed on his knees. When sitting, he can recover himself from the bent position with comparative ease. In some cases, contraction of the affected muscles takes place and deformities result; the earliest and most common being contraction of the calf-muscles, so as to produce talipes equinus. The pseudo-hypertrophied muscles retain considerably more power than the muscles which are merely atrophied. The electro-contractility of the muscles is unaltered, but of course in the later stages becomes impaired. The knee-reflex is absent. The general health of the patient is unaffected until the later stages of the disease. In many cases of pseudo-hypertrophic muscular paralysis there is some deficiency in mental power.

Duchenne divides the progress of pseudo-hypertrophic paralysis into three stages: In the first stage, lasting several months or even one or more years, there is merely weakness of the muscles, causing the peculiarities in the attitude, and in the mode of progression. Little or no enlargement of the muscles has taken place. During this stage proper treatment may bring about recovery. In the second stage the characteristic hypertrophy appears, and the weakness extends to the muscles of the upper limbs. This stage may last for years. In the third stage complete paralysis of most of the muscles of the upper and lower limbs and of the trunk supervenes. The patient lies helpless, unable to change his position. All the muscles, even those which were formerly hypertrophied, pass into a state of atrophy. The sufferer may live in this weak state until carried off by some intercurrent disease.

Pathology. — According to our present knowledge, pseudo-hypertrophic muscular paralysis is a perverted growth of muscle, with development in its substance of interstitial tissue and often fat, and consequent atrophy of the muscular fibres. The disease of the muscles is not secondary to morbid changes in the spinal cord, as was at first believed by many observers.

Diagnosis.—Pseudo-hypertrophic muscular paralysis has such peculiar and well-marked characters that it cannot easily be mistaken. It is readily distinguished from the various forms of spinal paralysis by the evident enlargement and unusual firmness of the paralysed muscles of the lower limbs. From spinal curvature, depending on disease of the vertebral column, it differs in this respect, that the curve of the spine which is present in pseudo-hypertrophic paralysis disappears when the patient sits or lies down.

Prognosis.—The prognosis is most unfavourable, but less so when the disease develops late.

Treatment.—This is only available in the first stage, before the hypertrophic symptoms are marked. Duchenne recommends localised faradisation and shampooing, and he records two cases which were cured by these means. The writer saw one case which had entered on the second stage, in which this treatment completely checked the progress of the malady, and even brought about considerable improvement in the strength of the lower limbs. This patient has since reached manhood with hardly any weakness or deformity, and in excellent general health. It is probable that massage and gymnastic exercises might prove useful. General tonic treatment is undoubtedly beneficial, but no medicinal remedies are known to have any

special control over the disease. Tenotomy may be required where muscular contraction has taken place, and if done early is very beneficial.

2. **Simple Idiopathic Muscular Atrophy.**—This form of myopathic atrophy is in many ways closely allied to the pseudo-hypertrophic form, but is much more rarely met with. There is here the same atrophic condition of the affected muscles, without the interstitial overgrowth of fibrous and fatty tissue. It resembles the hypertrophic form, too, in its tendency to run in families, but differs in the following respects: it affects both sexes equally; it rarely appears in early childhood, usually after the age of fifteen; and it commences oftener in the arms, or in some cases in the face, than in the legs. The reaction of degeneration is absent in the affected muscles. There is no morbid change in the spinal cord or brain. The *progress* of the disease is variable, generally very slow. The muscular atrophy may become universal. The *diagnosis* of this condition from muscular atrophy of spinal origin should not be difficult. The same *treatment* is to be employed here as in pseudo-hypertrophic paralysis.

ALEXANDER DAVIDSON.

PROLAPSUS (*pro*, forward; and *labor*, I slip).—This word signifies that an organ or structure has fallen or slipped down, but implies a greater degree of displacement than *procidentia*; so that the organ or structure may protrude through a natural or artificial orifice. The condition is of most importance in connexion with the rectum and the uterus. *See* PROCIDENTIA; ANUS, Diseases of; and WOMB, Diseases of.

PROPHYLACTIC } (πρό, before; and
PROPHYLAXIS } φυλάσσω, I guard). These terms are used in connexion with treatment, and indicate the means employed for the prevention of disease. *See* DISEASE, Treatment of.

PROSOPALGIA (πρόσωπον, the face; and ἄλγος, pain).—Prosopalgia signifies pain about the face. It may depend upon neuralgia of one or more branches of the fifth pair of nerves (*see* TIC-DOULOUREUX). Its paroxysmal character, unilateral position, and anatomical localisation will indicate this form. Another form is of rheumatic origin. In this the pain is more or less constant, diffused about the face or forehead, and does not follow the course of a nerve-branch. Movements, and especially stooping, increase it. Occasionally such pain is of syphilitic origin, and is especially apt to occur in connexion with the appearance of the secondary rash.

DIAGNOSIS.—In rheumatic prosopalgia the pain is diffused and increased by pressure. If it depend on syphilitic periostitis there will be tenderness on pressure, and the parts will be swollen and less elastic than normal. There will also very likely be a certain amount of fever; and the pain will be increased at night.

TREATMENT.—Chloride of ammonium in half-drachm doses, dissolved in half a tumbler of water, should be given every four hours. If there be any evidence of syphilitic infection, iodide of potassium should be given, in doses of from ten to twenty grains every four hours.

For the rheumatic form of face-ache five grains of iodide of potassium, with thirty grains of bicarbonate of potassium, may be given every four or six hours, after the administration of an aperient. This may be followed up by sulphate of quinine or iron. Locally, a mixture of equal parts of camphor, chloral hydrate, and menthol, rubbed down together in a mortar, may be applied; or a liniment containing chloroform, belladonna, and opium. Decayed teeth should be extracted.

T. BUZZARD.

PROSTATE, Diseases of.—SYNON.: Fr. *Maladies de la Prostate*; Ger. *Krankheiten der Prostate.*

It is not proposed in a work principally devoted to medical subjects to deal at all fully with the affections of the prostate gland; the present article must, accordingly, be taken rather as an index to guide the practitioner in his diagnosis, than as anything approaching a complete disquisition on their pathology or treatment.

GENERAL RELATIONS.—The points of practical importance in connexion with the anatomy of the prostate are as follows: In the examination of the rectum the healthy prostate is felt as a firm substance in the middle line, somewhat divided into two lateral lobes. The whole organ is about 1½ inch in width, with its apex opposite, namely, in the recumbent posture below, the apex of the pubic arch; that is, about 1½ inch from the anus, in a moderately thin subject, but much farther in a very fat one. The whole gland is 1½ inch in length, its posterior limit being usually about three inches from the anus—in other words, about the distance to which the forefinger can reach. From this it may be deduced that, as the *trigonum vesicæ* commences immediately behind it, a fully distended bladder masks more or less completely the natural outline of the gland. It may thus also be gathered that the vesiculæ seminales are beyond the ordinary reach of the finger, and that when these are infiltrated by disease, their apices, or perhaps only the vasa efferentia, can be detected. The practitioner should by no means neglect the digital examination of the prostate, as it will often yield information of the greatest value; and it may be observed that the best

position for the patient, if it be desired to compare the relative size of the lobes of the prostate, is the supine; whereas, if it be required to explore the rectum as far up as possible, the patient should be placed on one side with the hips flexed. The deviations from the normal type he may expect to meet with are —uniform or partial enlargement from simple hypertrophy, or from chronic or acute inflammation, in the latter case possibly attended by a sense of fluctuation, due to abscess; irregular hardness, most marked about the vasa efferentia, depending on a tubercular deposit; the existence of small hard nodular masses, which are calculi in the substances of the gland; or the irregular enlargement caused by a new-growth. It must be borne in mind that tumours or abscesses originating in neighbouring parts may surround the prostate and completely obscure its outline; thus the writer has met with the case of a large hydatid cyst between the rectum and the bladder that rather closely simulated malignant disease of the prostate, and effectually prevented its actual condition from being determined. It will not be forgotten that a certain degree of tenderness of the prostate does not imply a deviation from health, and that a more or less considerable enlargement in old age is so common as to be almost reckoned by some authors as normal. The effect of this enlargement on micturition will be mentioned farther on. The copious plexus of veins which surround the prostate communicates freely with those of the penis and rectum; and it is not unimportant, from a clinical point of view, to remember that these are thus connected not only with the systemic, but with the portal circulation. These veins may become the seat of phlebitis and its sequelæ from various causes.

The principal diseases of the prostate may be considered in the following order:—

1. **Prostate, Hypertrophy of.**—The results of Sir Henry Thompson's observations (*Clinical Lectures on Diseases of the Urinary Organs*) were, that one-third of all men over fifty-five have some enlargement of the prostate; but that a comparatively small number of these suffer any inconvenience from it; and that it usually begins between the ages of fifty-seven and sixty—rarely, if ever, before, though it may more rarely commence later. Very considerable enlargement of the lateral lobes may cause no inconvenience; but if the part which forms the floor of the prostatic urethra, the so-called middle lobe, be even slightly enlarged, or if, as has been shown by McGill, a ring of prostate tissue be formed at the neck of the bladder, difficulty in micturition is sure to result. It is thus easy to understand how a simple hypertrophy may reach enormous dimensions without giving rise to symptoms, while those which are caused by the enlargement of a prostate, which feels almost normal to the finger introduced into the rectum, may, on the other hand, be very severe indeed.

Symptoms.—The symptoms are briefly these: The stream of urine becomes dribbling, and there is an obvious difficulty in emptying the bladder; there is frequency of micturition, especially at night and in the early morning; perhaps a little pain before the act, but none afterwards; and no alteration in the character of the urine. If unrelieved, these early symptoms are followed by incontinence, depending upon over-distension of the bladder; and, from the same cause not improbably, cystitis and dilatation of the bladder, dilated ureters, and, perhaps, pyelitis and chronic interstitial nephritis. Patients with chronic hypertrophy of the prostate usually suffer from time to time from attacks of acute congestion, such as are described later on.

Anatomical Characters.—The structure of a hypertrophied prostate is but a slight modification of that of the gland itself.

Treatment.—In regard to treatment of hypertrophy of the prostate, it is only necessary here to give two words of warning. First, that most of the evils resulting from this condition depend upon the fact that the bladder is never emptied. It is essential, therefore, that the patient's powers in this respect should be ascertained without delay by catheterisation, and if it be discovered that a certain amount of residual urine remains, he should be taught to pass an instrument himself, and directed to do so at least once a day. Secondly, cystitis has often been caused by setting up putrefaction of the urine by a catheter not surgically clean. The simple precautions of washing it before and after use in an antiseptic solution (say 1 to 20 carbolic acid, or 1 to 2,000 sublimate), and of lubricating it with carbolised oil (1 to 10 or 1 to 15) which has not been too long prepared, will avert with certainty this catastrophe, and prevent the unnecessary loss of many lives. The reader must consult surgical works as to the difficulties which an enlarged prostate offers to the introduction of a catheter, and the manner in which they may be overcome. A method of removing the middle lobe or the ring of prostatic tissue, referred to above, has been suggested by McGill, and practised with success by him and others.

2. **Prostate, Congestion of.**—Congestion is a condition which follows on chronic hypertrophy, and is commonly known as 'an attack of the prostate.'

Symptoms.—An old man, suffering from the symptoms already described, is suddenly seized—as the result of some indiscretion in diet, an exposure to cold, or some other apparently trivial cause — with complete retention, accompanied by bloody urine,

possibly a raised temperature and quick pulse, and considerable local uneasiness. If the case do not improve, and especially if the urine be allowed to putrefy, the tongue becomes dry and brown, the pulse more rapid and weak, and the patient passes into a low typhoid condition, which is not unlikely to end fatally.

Treatment.—The treatment is in large measure surgical, consisting in the proper passing of catheters. Scarcely less important are the careful regulation of the bowels and the administration of a diet sufficiently light, and yet not too lowering, together with, in most cases, a certain amount of stimulant, for it must be remembered that the patient is probably weak, and that death from asthenia is much to be dreaded. The writer would again urgently insist on the importance of preventing putrefaction of the urine, which is the most fertile source of death in such cases; he can affirm from experience that this end may be attained by the thoughtful employment of antiseptic treatment, even in those cases in which it becomes necessary to keep the bladder empty by tying a catheter into the urethra.

3. Prostate, Chronic Inflammation of.—Synon.: *Chronic Prostatitis.*—This is not an uncommon affection amongst young and middle-aged men, depending most frequently on a prolonged gonorrhœa, in which the prostatic part of the urethra has been involved.

Symptoms.—The symptoms of this disease resemble rather closely those depending upon stone in the bladder, namely, more or less frequent micturition, with a feeling of heat and weight in the perinæum, and pain, not usually severe, along the penis, extending to the tip; there is also at times a little blood passed at the end of micturition; and all the symptoms are aggravated by exercise. Generally there are frequent nocturnal emissions. The urine is cloudy, and on standing yields a muco-purulent deposit containing small white filiform shreds. A rectal examination shows that the prostate is enlarged, sometimes very slightly, and seldom to any great extent; it is always tender, but the tenderness is not, as a rule, great. The diagnosis can scarcely be made without passing the sound.

Treatment.—The treatment consists in rest, the administration of laxative medicines, and the application of blisters or some other form of counter-irritation to the perinæum; alcoholic stimulants are to be avoided; and the urine should be rendered bland by alkalis and diluents, as in cases of urethritis.

4. Acute Inflammation of the Prostate.—Synon.: *Acute Prostatitis.*—Acute prostatitis may arise as the result of a gonorrhœa, or of cystitis; from the irritation produced by calculi or other mechanical causes; perhaps sometimes idiopathically, or from exposure to cold or wet; and from undue sexual excitement, or the too free use of alcohol if gonorrhœa be present. It may occur in men of any age, and is accompanied by symptoms such as those depending on chronic inflammation, but much more intense; the frequency of micturition and pain during the act causing sometimes almost unbearable agony, and the dysuria amounting in some cases to complete retention, while the tenderness of the gland is very great, a condition which makes an action of the bowels very painful. Such cases may terminate by becoming chronic; they may undergo complete resolution; or suppuration may occur. In any case there will probably be some elevation of temperature, and in the event of the formation of abscess there may be great and sudden rises and falls, accompanied by rigors and sweatings, with a dry, brown tongue, forcibly suggesting pyæmia. Rectal examination reveals a large, hard, and excessively tender prostate. The enlargement may be symmetrical or unilateral. If an abscess have approached the surface, its position will be indicated by a soft boggy sensation. Prostatic abscess may burst into the rectum, bladder, or perinæum.

Treatment.—The treatment of acute prostatitis consists in rest, and carefully regulated diet; diluent and alkaline medicines; purgatives; local blood-letting from the perinæum, by leeches or otherwise (some French surgeons have recommended the application of leeches to the interior of the rectum); with hot fomentations, and morphine suppositories. If an abscess forms it may be opened through the rectum, but it is better to incise it through the perinæum, as this plan is most likely to prevent the formation of that most troublesome and almost incurable condition, a recto-vesical fistula.

Abscesses sometimes form *around* the prostate (periprostatic). They are not so likely to involve the danger of the formation of a recto-vesical fistula; and they should be treated by early incision.

5. Prostate, Tubercle of.—This, though not a common affection of the prostate, occurs perhaps more frequently than is generally supposed, and is of great interest, not only on account of its special features, but because it is usually a part only of a more or less general affection of the genito-urinary tract. Thus in cases where the epididymes are hard and swollen and the cords knotty from tubercular deposit, the finger introduced into the rectum will probably detect a hard nodule in one or both of the vasa efferentia. This, if seen *post mortem*, is found to consist of a tubercular or cheesy mass, and if the condition have advanced farther, the prostate itself may have become involved: there may be either separate nodules of tubercular deposit in a more or less advanced state of cheesy or, more rarely, calcareous degeneration; or the whole gland may have become hollowed out

into an irregular cavity, filled in part with cheesy material, and discharging pus.

Symptoms.—This disease may begin in childhood, or in adult life. Its symptoms are most obscure. At first there are probably none at all; but as the disease advances, there will arise those of tumour of the prostate, together, perhaps, with those of abscess; that is, there will be occasionally blood, and generally pus, in the urine; frequency and pain in micturition; tenderness and swelling in the rectum, and so forth. Abscess from this cause has been known to burst into the peritoneum.

Treatment.—The treatment can only be palliative, and must be directed to the relief of the symptoms as they arise; but at the best it is unsatisfactory. Occasionally it may be possible to open a tubercular abscess through the perinæum, but it is doubtful how far such a procedure is to the advantage of the patient.

6. **Prostatic Calculi.**—These are small bodies, generally multiple, formed in the glands of the prostate, usually late in life, but occasionally in comparatively young men. They probably begin as a deposit of animal matter; but later they are made up principally of phosphate, and partly of carbonate, of lime. They may produce no symptoms at all, or they may project into the urethra, and give rise to great irritation at the neck of the bladder, and the symptoms of vesical calculus; such will also be present if, as sometimes happens, they convert the whole gland into a single cavity, in which the calculi lie side by side. In this case they will be felt through the rectum, rubbing against one another; and indeed prostatic calculi, unless they be very small, are, as a rule, to be felt in this situation.

Vesical calculi of considerable size may become encysted in the prostate; and, on the other hand, prostatic calculi may find their way into the bladder. Prostatic calculi may give rise to abscess.

If any treatment be required, it is purely surgical, and must consist in the removal of the stones by forceps, a lithotrite, or a perineal incision.

7. **Prostate, Phleboliths of.**—The pathologist very often meets with phleboliths in the veins surrounding the prostate, the result no doubt of old phlebitis.

8. **Prostate, Tumours of.**—The so-called *fibrous tumours* of the prostate are in all probability simply local hypertrophies, and are composed principally of plain muscular tissue. *Cystic disease* is described as a pathological rarity, the gland being occupied by numerous cysts, containing serous or mucous fluid. *Melanosis* of the gland has also been observed. *Cancer* of the prostate occurs not very infrequently, and is usually soft, though it is sometimes hard enough to be worthy of the name of scirrhus. The writer would speak with great caution of malignant tumours of the prostate; such as he has himself examined have been cancers, with a very irregular arrangement of both stroma and epithelial cells.

Tumours of the prostate may be at present considered as beyond the reach of surgical interference, though suggestions for their removal have been gravely made in Germany.

9. **Prostate, Atrophy and Absence of.**—Atrophy of the prostate is said to occur as the result of pressure, sometimes from an unascertained cause, or from simple senile decay. Congenital absence of the prostate has also in rare cases been observed, but is of little clinical interest.

R. J. Godlee.

PROSTRATION (*pro*, forward; and *sterno*, I stretch).—This word signifies both the act of overthrowing; and the condition of being overthrown, overcome, or depressed. In medical science it is generally employed in the latter sense; and is used to express a condition of system in which the bodily energies as a whole, or the more active of them, have so completely succumbed to the effects of injury, disease, or powerful emotional influences, that they cannot be made to respond to ordinary stimuli. When prostration affects the *whole* system, the patient is said to suffer from *general prostration of the vital powers*. The principal forms of prostration of a *single* system, on the other hand, are—(1) *muscular prostration*, in which there is complete exhaustion of the voluntary muscles; and (2) *nervous prostration*, in which the nerve-centres, and especially those associated with the mind, are so completely overpowered that sensation and motion appear to be in a measure temporarily suspended.

The causes, symptoms, and treatment of prostration in its several forms are more fully discussed in other articles. *See* Collapse; Debility; Exhaustion; Shock; and Syncope.

J. Mitchell Bruce.

PROXIMATE CAUSES (*proximus*, nearest).—A synonym for the immediate or exciting causes of disease. *See* Disease, Causes of.

PRURIGO (*prurigo*, the itch).

Definition.—Prurigo is a severe and chronic disease of the skin, characterised by intense pruritus, and the formation of large, pale, scattered papules.

History and Symptoms.—Prurigo is comparatively rare, and until lately was overlooked as a distinct disease by English writers, who usually described cases of it as those of congenital eczema. This is explained by the fact that the disease is often masked by a great deal of superadded eczematous eruption, which is much aggravated by the scratching of the patient. 'In every case,'

says Hebra, 'the earliest appearance is that of sub-epidermic papules as big as hemp-seeds, and recognised rather by touch than by sight, since they rise but little above the level of the skin, and do not differ from it at all in colour.' The development of these papules is attended with intense itching, and consequently the tops of the more prominent ones are soon scratched off, and a little drop of blood escapes, forming a small dark crust at the summit of the papule; this gives to the disease one of its characteristic appearances. When the affection has lasted for a considerable time, we notice that the skin becomes dark from increased pigmentation, and at the same time thicker and harder than normal, so that it is difficult to pinch it up between the finger and thumb; the parts affected become more or less eczematous, so that the eruption is somewhat masked; and the lymphatic glands in the groin become enlarged.

The regions of the body most commonly affected are the trunk, the buttocks, and the extensor surfaces of the limbs, especially the forearms and the legs below the knees. The scalp, the armpits, the flexor sides of the wrists and elbows, the palms and soles, groins, and hams are generally unaffected, even in severe cases. The lines and furrows of the skin become more plainly marked than normal on the parts attacked; this is especially noticeable on the backs of the wrists and on the forehead, which gives the patient a peculiar expression when the face happens to be a seat of the disease. The skin assumes a rough and brawny texture, which is more easily detected by touch than by sight.

Prurigo, though not strictly congenital, appears first at a very early age. The early form of the eruption is very often like that of lichen urticatus; at other times it closely resembles a papular eczema. As, however, age advances, the distinctive characters of the disease become more marked. The malady is generally worse in the winter than in the summer, and in a severe form is almost incurable.

In addition to the above-described prurigo of the young, we also meet with a spurious form of the malady which first shows itself in old age, and is commonly known as *prurigo senilis*. The eruption in this case is greatly aggravated, if not entirely produced, by the scratching of the patient.

Diagnosis.—The word 'prurigo' is sometimes colloquially misapplied when simple pruritus is meant; thus, we often hear the expression 'prurigo senilis' used when no eruption is present. These cases are generally either examples of chronic urticaria or of senile changes in the cutaneous nerves, leading to excessive and persistent itching. For the reasons already indicated, prurigo is more often mistaken for severe congenital eczema than for any other disease. Careful examination, however, of those parts of the body which have not been much scratched, together with the distribution of the eruption, will generally lead to a correct diagnosis. The malady may also be mistaken for scabies or phthiriasis, but in both these diseases the parasite can be detected, and in scabies the distribution of the eruption and the history of the case are quite different from those of prurigo.

Treatment.—As has already been stated, prurigo, in a severe form, is incurable, but rest in bed for a few weeks always has a markedly beneficial effect. The itching may be greatly relieved by warm borax and soda baths, followed by the inunction of carbolised oil, or some similar application. Sometimes a very weak sulphur ointment is useful in relieving the itching; also a weak ichthyol ointment. Internal remedies do not appear to be of much value. Arsenic is, however, often useful in helping to get rid of the eczema which is so frequently associated with the disease. Robert Liveing.

PRURITUS (*prurio*, I itch).—Synon.: Fr. *Prurit*; Ger. *Jucken*.

Definition.—A form of perverted sensation of the skin, and most external parts of the mucous membranes, characterised by itching.

Ætiology.—General pruritus may accompany senile degenerative change of the skin (*pruritus senilis*). Apart from scabies and other defined diseases giving rise to itching, pruritus most often accompanies hepatic derangement, functional or organic; dyspepsia, Bright's disease, or diabetes mellitus. Pregnancy or ovarian or uterine disease may cause it; also depression of the mind. Local pruritus is more often due to local causes. The season of the year may determine pruritus, hence P. hiemalis (Duhring).

Symptoms.—Pruritus may be local or general, slight or severe, continuous or intermittent. It is generally most marked at night. Local forms are—

(a) *Pruritus genitalium.*—This form is chiefly found in women with uterine disease, such as a granular condition of the os uteri, or during pregnancy, or at the change of life. Diabetes is a frequent cause, and should always be sought for. In children, ascarides of the rectum or in the vagina, or other irritating causes in the rectum, may be present. In men, *P. scroti et penis* is more often the result of eczema or uncleanliness. Pruritus on and around the pubes should always suggest the presence of *pediculi pubis*.

(β) *Pruritus ani.*—This is usually connected, in adults, with piles, eczema, or profuse sweating; and in children with thread-worms.

Diagnosis.—It is essential to remember that pruritus is most often a symptom of external irritation, and care should be taken to exclude in the diagnosis such conditions

as pediculosis and scabies; other parasites must be remembered—gnats, bugs, fleas, &c.; coarse articles of clothing may be the cause. After exhausting these, the above-mentioned causes, such as dyspepsia, should be investigated, aud the urine examined in all cases.

Possibly we may have to do with urticaria, uo lesions being visible. In such cases there would be a history of wheals at some period of the disease. In local forms, such causes as those suggested must be searched for.

Treatment.—For general pruritus, if no cause can be found, the diet must be simple, and the bowels freely relieved. If causes exist, such as dyspepsia or hepatic trouble, these must be dealt with ou general principles. These measures failing, cannabis indica may be tried, ♏ x. of the tincture, increased to ♏ xx., three times a day, well diluted with mucilage, and taken after meals. As external remedies, the following lotions will be found useful: Liquor carbonis detergens ʒij., water to ℥viij.; carbolic acid in water 1 in 60; perchloride of mercury gr. j.–ij.; water ℥j.; this possesses the advantage of being odourless. Camphor and chloral, equal parts, rubbed down in a mortar to liquefaction; this may be used pure or diluted. Baths are useful containing alkalis, or sulphurated potash ℥iv. in 30 gallons of water. For pruritus vulvæ strong solution of subacetate of lead ʒss. to ℥j. of water; or a solution of nitrate of silver gr. v.–xx. to ℥j. of water, may be painted on every two days, or the compound tincture of benzoin may be painted on every night. For pruritus ani, mercurial ointments containing ammoniated mercury gr. x.–xx. to ℥j. of lard, or calomel gr. x. to ℥j.; these may be combined with carbolic acid or creasote. Sponging the scrotum or vulva with water as hot as it can be borne generally gives relief for a time.

Edward J. Sparks. Alfred Sangster.

PRUSSIC ACID, Poisoning by.—Synon.: Fr. *Empoisonnement par l'Acide Cyanhydrique*; Ger. *Cyanwasserstoffsäurevergiftung.*

Prussic or hydrocyanic acid is one of the best known and most deadly of poisons. In the anhydrous condition it is stated to kill with almost lightning-like rapidity. Prussic acid is met with in commerce only in a diluted state. In this country two strengths of prussic acid are usual, the Pharmacopœial acid containing 2 per cent., and the so-called Scheele's acid containing about 4 per cent., of anhydrous prussic acid in aqueous solution. The soluble cyanides, more especially cyanide of potassium, largely used by photographers and by electro-platers, are common articles of commerce, and produce the same deadly results as the acid itself. The fatal dose of prussic acid is the equivalent of about one grain of the anhydrous acid.

Anatomical Characters.—In persons who have died of prussic acid poisoning, the eyes are glistening; the extremities are blue; the face is pale or livid; and the lips are cyanosed. The blood throughout the body has frequently the peculiar odour of the acid, and is of a dull hue, with a peculiar bluish cast—a glimmering appearance. The stomach is sometimes reddened, but not more than is common after other asphyxial modes of death.

Symptoms.—In fatal doses the symptoms of prussic acid poisoning set in very speedily; and in consequence of the readiness with which this poison is absorbed from the alimentary canal, and diffused throughout the circulation, the onset of symptoms is reckoned by seconds rather thau by minutes. Occasionally the patient may be able to walk into an adjoining room, to compose himself in bed, or perform like actions; but it is rarely that he will have time to dispose of the cup, glass, or bottle in which the poison was contained, before he is taken seriously ill. The symptoms may be divided into three stages. The *first stage* is very brief, and manifests itself by difficult respiration, slow cardiac action, with a tendency of the heart to stop in diastole, whilst its beats are irregular. There is disturbed cerebration, and an awestricken aspect of countenance. This preliminary stage speedily ushers iu the *second* or *convulsive stage*, the onset of which is occasionally signalised by a piercing shriek, though this is less frequently observed in man than in animals. With widely dilated pupils, the patient is suddenly thrown into violent clonic aud tonic convulsions. The respiration is marked by shortness of inspiration, and prolonged efforts at expiration. The countenance becomes cyanotic. Vomiting is commonly observed; and the urine, fæces, and even semeu in the male are spasmodically evacuated. The patient now sinks down, probably in a state of unconsciousness, and with complete loss of muscular power. The convulsive stage speedily passes into the *third*, or, as it may be termed, *asphyxial stage*, with slow, gasping, stertorous respiration, extreme collapse, loss of pulse, and more or less complete paralysis of motion. The skin is cold, clammy, and cyanosed. Death may be ushered in with irregular spasms. The onset of symptoms being rarely delayed beyond oue or two miuutes, death may occur within two or three minutes more. Power of volition is rarely continued in fatal cases for more than two minutes after taking the poison. Fifteeu minutes is the longest interval which has been known to elapse between the taking of the poison and the commencement of symptoms; and then the patieut recovered. Should the patieut survive for thirty minutes, good hopes may be entertained of recovery. The longest period which is kuowu to have elapsed between the taking of the poison and death was oue hour and a quarter.

DIAGNOSIS.—This is rarely difficult. The *foudroyant* character of the illness, and the usually speedy death of the patient, coupled with the peculiar odour of the acid, and the finding of a cup or glass containing the remnants of the dose, seldom leave any doubt as to the nature of the case. Nitro-benzol poisoning closely simulates prussic acid poisoning, however, except that the onset of symptoms is generally much later in nitrobenzol poisoning than when prussic acid has been taken. Nevertheless, when crude bitter-almond oil, impure from the presence of prussic acid, has been swallowed, the close similarity between the odour of the oil and that of nitro-benzol may lead to error. Fortunately, the same treatment may be adopted in both cases.

PROGNOSIS.—This in all cases is very doubtful; and no general rules can be laid down.

TREATMENT. — Prompt inhalation of the fumes of ammonia should, if possible, never be neglected. The successive administration of a solution of the mixed per- and protosalts of iron, followed by an alkaline carbonate, so as to convert the acid into an inert ferrocyanide, has been recommended on purely chemical grounds. There is, however, seldom or never time to admit of this elaborate treatment. A more practicable mode is to treat the patient with alternate douches of warm (115° F.) and cold water, so as to stimulate the respiratory functions; artificial respiration may also be employed, together with friction of the limbs. An emetic should be administered. Faradic currents of electricity to the cardiac region should not be neglected. Atropine is not, as has been asserted, a true physiological antidote to prussic acid; but, injected subcutaneously, it may be of use as a respiratory stimulant. Spite of all treatment, the patient usually succumbs. THOMAS STEVENSON.

PSEUDO- (ψευδής, false).—This is used as a prefix to various names of conditions, and signifies that they simulate certain diseases or conditions which they really are not; for example, *pseudo-angina*, *pseudo-asthma*, and *pseudo-cyesis*.

PSEUDOCYESIS (ψευδής, false; and κύησις, pregnancy).—A synonym for spurious pregnancy. *See* PREGNANCY, Diseases and Disorders of.

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.—*See* PROGRESSIVE MUSCULAR DYSTROPHY.

PSEUDO-TABES.—A term, signifying false tabes or locomotor ataxy, which is given to certain forms of multiple neuritis occurring more especially after poisoning by alcohol, arsenic, or as a sequence of diphtheria, in which the paralytic symptoms are generally slight, but where the muscular sense and other modes of sensibility are more or less involved, with the result of producing an ataxic condition of the limbs. *See* NEURITIS, MULTIPLE.

PSILOSIS (ψιλός, bare).—SYNON.: *Psilosis Linguæ et Mucosæ Intestini*; Popularly known in the East as 'Sprue,' a term applied to the disease by the Dutch, the word having reference to the symptoms in the mouth.

DEFINITION.—A chronic disease of the digestive tract, so far as is known occurring only in certain parts of Asia; unattended by fever; the most marked symptoms being diarrhœa, rawness and soreness of the tongue and throat, with a disposition to superficial ulcerations of the buccal mucous membrane, the presence of dyspeptic symptoms of various kinds, the passage of characteristic frothy, yellowish, or greyish-yellow, pultaceous stools, progressive debility, emaciation, and, in unfavourable cases, terminating in death from atrophy and exhaustion; the disease in such cases usually lasting over several years.

ÆTIOLOGY.—The disease is climatic. Cases of it occur in Ceylon, the Straits Settlements, Indo-China, Java, Manila, and apparently the whole coast of China, more particularly the south. The cause is unknown, but the probability of a bacterial origin is considerable. In one case the writer found that a particular rod-bacterium prevailed in the motions in numbers over the other organisms in proportion as the disease was aggravated; and in cultivation-experiments this organism liquefied the gelatine with great rapidity. In two recent cases under the writer's care, Dr. Wethered found a similar-shaped bacterium present in almost pure cultivations in enormous quantities.

ANATOMICAL CHARACTERS.—The pathology of this disease has not yet been much investigated, although it has been recognised for some time that in fatal cases the small intestine is thin, shining, and translucent; generally in a condition recognised as atrophic, and lined by a covering of mucoid material which gives to the gut a peculiar velvety feel when handled, as though there had been some thickening of the coats, which, however, does not occur. The only case known to the writer in which the intestine has been examined microscopically is described by him in a paper in the *British Medical Journal* for June 14, 1890, which contains a report by Dr. Wethered of a careful examination he had made in a fatal case which was under the writer's care. In this case the stomach, duodenum, upper part of jejunum, and large intestine were found practically healthy. The tongue was found to be denuded of its epithelium in certain circumscribed parts. The whole of the œsophagus was extensively diseased, the lining and glandular epithelium of the tube

being entirely destroyed, and the surface formed by the bare submucosa. In the lower part of the jejunum there was slight inflammatory exudation around Lieberkühn's crypts, with a little destruction of the follicles at some parts. In the ileum the mucosa was almost entirely destroyed, its place being taken by a soft structureless substance. The submucosa was thickened, and contained an abundance of fibrous tissue of a solid character. The coats of the blood-vessels were thickened—a condition of sclerosis.

SYMPTOMS.—The symptom to which the patient's attention is most directed is the occurrence of diarrhœa, which varies, however, very greatly in different cases. Sometimes it begins insidiously, the one irregular loose motion in the morning scarcely attracting attention, and it might be overlooked entirely if there were not other symptoms associated with it, such as griping and general uneasiness. In other cases the diarrhœa is more marked from the beginning, the patient having several loose motions during the early morning without any further diarrhœa until the following day. There are cases, on the other hand, of which the writer has recently observed one well-marked example, in which the disease begins with a sudden acute diarrhœa which lasts unchecked by remedies, within a short time other characteristic symptoms being observed. The amount of diarrhœa frequently bears no proportion to the other symptoms, being sometimes comparatively slight in otherwise well-marked cases. The motions are characteristic. At the outset they may consist of a copious discharge of a pale straw-coloured yellowish fluid, which is passed especially in the early morning, causing considerable weakness. During the day this diarrhœa ceases, the patient feels gradually stronger as the day advances, and towards the afternoon he usually feels quite well. In this way he may neglect his condition entirely for a period of many months, during which time he is gradually but steadily losing strength and weight. Sooner or later, but sometimes at the beginning, the motion is more characteristic of the disease, consisting of the discharge of large quantities of a pultaceous mass, frequently of a putty or slate colour, sometimes pale yellow, sometimes brown. During periods of aggravation this large pultaceous discharge may contain an admixture of minute thread-like portions of a whitish substance. The motions have always a tendency to be frothy. When they consist of the abundant putty-coloured pultaceous mass, the frothy appearance on the surface is often found covered with air-bubbles of various sizes, as if a process of active fermentation were going on. Stools of this latter quality are characteristic of the fully developed stage of the disease. In cases that do badly, the motions, during this stage, may vary considerably from time to time, sometimes being of a watery or a dirty brown colour, and at other times of a light yellow, with intervals of the return of the pultaceous stool, which is found to contain, if carefully examined, portions of whatever food the patient is taking passed quite unchanged. Even when allowance is made for the large quantity of watery discharge in the motions, the quantity passed is out of proportion to the amount of nourishment taken, showing habitual deficiency of absorption in the intestine.

Early in the disease, and simultaneously with the disordered condition of the bowels, the patient becomes conscious of a tenderness in the mouth. At first there may be simply intolerance of hot food (as regards temperature), or of hot condiments, or of alcoholic drinks. Pepper, sherry, &c., burn his mouth, the tongue particularly. At the same time the tip of the tongue is felt to be tender when pressed against the teeth. This tenderness may lead to a slight defect of articulation. In the early stages the tongue may be observed to be covered with a shining white fur, which is deficient at certain parts, showing patches of a bright red; the tip particularly, as well as the sides, being of a bright rosy red colour. When the tongue is tilted up, the under-surface is seen to be redder than usual, and generally with some parts redder than the rest. As the disease progresses the fur gradually disappears, large papillæ being prominent for a time. While this process is going on, there may develop on any part of the tongue, but more usually on the tip and at the sides and under the tip, characteristic superficial ulcers, which, while they destroy the investing epithelium, do not extend into the subjacent tissue. These painful superficial ulcerations may vary in size from a pin's head to a threepenny piece, or sometimes even larger, the larger ones being usually found in the mucous membrane of the cheek. The gums may become swollen, tender, and prone to bleed. Sometimes one large solitary ulcerated patch may exist on the cheek or lip. Eventually the fur completely disappears from the tongue, which becomes apparently entirely denuded of epithelium, no papillæ being visible, and the whole surface presenting a dull red colour, more or less traversed by longitudinal and transverse furrows, the portions between these furrows being smooth. In some cases, in the advanced disease the tongue is very red, dry, glazed, and shining, and may or may not present cracks and crevices. The extreme anæmia which sometimes becomes a prominent symptom [1] produces a peculiar

[1] The anæmia in this disease possesses peculiarities that well merit further attention. In a man, aged thirty, under the writer's care, in whom the disease was well marked, but not in an advanced stage, Dr. Wethered found the number of red corpuscles reduced to 2,000,000 per cubic millimetre,

appearance in the tongue, the part towards the tip being of a pale tallow-like colour. At this stage the mucous membrane of the cheeks, lips, and palate (where not the seat of superficial ulceration) is of a dull, very pale yellow colour. There are rare cases in which the affection of the tongue is almost the only symptom present, the patient being unconscious of any diarrhœa, although the motion when examined will be found to be slightly altered in colour or consistence. The patient in these cases complains bitterly of the irritability of the mouth and soreness of the tongue, but does not otherwise feel especially distressed.

The rawness is not always confined to the tongue. The passage of hot food or drink may be painfully felt in the whole course of the gullet, the tender condition of this tube sometimes rendering the swallowing of solid morsels extremely painful and difficult, and giving rise to prolonged and painful hawking, vomiting, and sometimes coughing. This condition occasionally develops early, and may be out of all proportion to the other symptoms, the patient sometimes requiring to get up five or six times during the night to rinse his mouth with water in order to relieve the dry hot sensation from which he suffers.

At an early stage of the disease dyspeptic symptoms develop, and sometimes give rise to much distress, the patient being troubled with flatulence, heartburn, and sour eructations. He suffers from a capricious appetite, sometimes characterised by a craving for meat. After the disease has lasted some time, and when the will is weakened from the progressive debility, frequently the patient cannot be restrained from indulging in various kinds of highly indigestible foods, which are found in the stools absolutely unchanged, and which increase his sufferings and weakness by exciting considerable diarrhœa.

The mental condition of the patient is noteworthy. He is irritable, frequently depressed, and towards the later stages of the disease often extremely difficult to manage, refusing to acknowledge the gravity of his condition, and insisting on indulgence in foods which he cannot digest.

Course and Terminations.—The disease is essentially a chronic one, being unattended by fever. The urine is usually free from albumen. The liver gradually shrinks in size, and eventually it becomes very small; but there is no reason to believe that this organ is primarily at fault. Such *post-mortem* evidence as has been obtained negatives the idea that the frequent paleness of the motions is due to any affection of the liver.

the proportion of white corpuscles to red being 1 in 160. On the other hand, notwithstanding this great diminution of the red corpuscles, there was 68 per cent. of hæmoglobin. (By Fleischl's hæmometer.) After a month of milk diet the red corpuscles had increased to 3,580,000 per cubic millimetre, the proportion of white corpuscles to red being 1 in 190, whilst the hæmoglobin was 65 per cent. There was thus, in this case, with an extraordinary diminution of the red corpuscles, a comparative increase in the percentage of hæmoglobin.

The abdomen, except at the very beginning and the very end of the disease, is usually tumid, bulging in the epigastrium, tympanitic, giving a soft doughy feeling to the touch; the tumidity being more noticeable as the patient progressively emaciates. The disease, which may last for a period of years, is attended with general atrophy and anæmia, the subcutaneous fat gradually disappearing till the patient reaches an extreme stage of emaciation, which, combined with the projecting eyes, pearly conjunctiva, and extreme pallor, give rise to a peculiar and characteristic appearance. In the later stages, and whilst recovery is still possible, there may be considerable œdema of the legs, with a rough harsh skin. In fatal cases the patient usually sinks with great slowness, death being mainly brought about by his being essentially starved to death, the processes of digestion and absorption having been for a considerable time almost entirely annihilated.

Diagnosis.—This disease might possibly be mistaken for dysentery by the inexperienced, and is apt to be confounded with various forms of diarrhœa which are common in the tropics. In chronic dysentery, the mucus in the stools, the evidence of local irritation in the colon, inclination to strain, and the previous history of the attack, together with the absence of the characteristic symptoms of psilosis, ought to be sufficient to prevent any confusion between the two diseases. At the beginning of the malady it might be difficult to distinguish psilosis from other forms of diarrhœa, but after a time the condition of the tongue, mouth, and gullet, and the characteristic pultaceous stools which have been described, ought to be sufficient to establish the diagnosis. In simple diarrhœa of the tropics there is not present the peculiar local changes in the epithelium of the tongue and mucous membrane of the mouth, nor are the symptoms in the gullet present which are characteristic of psilosis; and those who are experienced in both affections should have little difficulty in distinguishing the frothy pultaceous masses of the latter disease. The peculiar changes in the mouth and throat are typical and distinctive. In the last stages of psilosis and of prolonged tropical diarrhœa the symptoms of exhaustion and emaciation are much the same; and in chronic exhausting diarrhœa the tongue may become bare and raw, with a formation of numerous aphthous spots in the mouth, which still further tends to obliterate the lines of distinction between the diseases in the fatal stages. In such cases it is necessary to take into account the previous history of the case.

Prognosis.—Psilosis is always a grave disease, its gravity increasing in proportion to the age of the patient. In the earlier stages it is very difficult to get the sufferer to realise the serious nature of his malady. Patients under forty, who are willing to undergo the self-denial of suitable treatment, will probably recover, particularly if they remove to a temperate climate; but relapses are apt to occur for one or two years after recovery is apparently complete, particularly if the patient returns to a country where the disease is endemic. In patients who are middle-aged, and particularly those who are over fifty, the gravity of the disease is much increased; but even at this age, if the constitution has been naturally strong, permanent recovery may take place in cases in which the disease has lasted over a considerable period. In all cases, even the slightest, it is advisable to point out to the patient and his friends that the gravity of the case is out of proportion to the mere amount of diarrhœa present.

Treatment.—The treatment which has been found on empirical grounds to answer best is in accordance with what has been recently ascertained in connexion with the morbid condition of the small intestine. The object is to give the weakened bowel (ileum) as complete rest as possible. The patient should be instructed to keep his bed for several weeks, after which time the probable improvement of the symptoms usually permits his spending part of the day on the sofa or in an easy chair; but experience has shown that there is great advantage in maintaining the recumbent posture for some time. A flannel bandage should be applied to the abdomen. An exclusive milk treatment is then begun. Pure fresh milk should be given tepid, at intervals of an hour or even less from early morning to late evening, the quantity given each time being calculated in accordance with the total quantity allowed. A small person will do very well for a time on four pints a day. This is about the minimum quantity given in the writer's experience. In the case of a man of ordinary size, he begins with five to six pints daily, and in a large person even more. From three-quarters to one tumblerful is found to be the usual quantity given each hour. In favourable cases the improvement begins to be evident within a few days; the soreness disappears from the mouth; the motions become gradually more consistent, until eventually they become solid, the colour remaining for some time white and creamy-looking.[1] When the motions become solid, the quantity of milk is gradually increased until eight or even nine pints or more are given. After a few weeks there is usually considerable constipation, giving rise to pain and soreness, and necessitating frequently the use of an enema. At this period rhagades are apt to form at the anus, and require to be touched with nitrate of silver. After the bowels have remained regular for several weeks, gradual additions are made to the diet; but here we find much difference in the idiosyncrasies of individual patients. Arrowroot is usually first given in small quantities in addition to the milk, and beef-tea is usually well borne. After these have been added for a week, if there be no return of the symptoms, one or two raw eggs a day may be tried; but there are cases in which eggs disagree. At the same time, stale bread soaked in hot water, pressed, and eaten with milk and sugar, is usually well borne, and greatly adds to the patient's strength. After a week or a fortnight of this diet, the patient may be tried cautiously with boiled white fish—whiting, haddock, or sole. The next change in diet should be a few ounces of chicken or partridge, and after some days this may be alternated with boiled mutton, after which time cauliflower may be tried. About the same time that fish is given fruit may be tried, bananas or grapes, the skins and seeds being rejected. In connexion with all these articles of food, it is important to bear in mind that any one of them may in some patients cause a relapse of the symptoms. When a relapse occurs the patient should be at once put back on milk diet, and kept on it for four or five days, when the additions to diet may be again begun, this time avoiding the particular article of food that had been found tc disagree. The writer has known relapses produced by eggs (which are usually well borne) after recovery had begun. Although fish is usually well borne, he has known a relapse brought on by boiled whiting, and so on with almost every article of food he has tried, with the exception of milk. Unfortunately, there are cases, although very rare, in which milk cannot be borne, and indeed seems to aggravate the symptoms, in which case koumiss or simply aërated milk should be tried; and if these also fail we must fall back on the expressed juice of raw meat, strong beef-tea, chicken jelly, and such-like substances. On account of the tendency to relapse, the patients require to be encouraged and reassured, as in well-managed cases the relapses usually do not last more than four or five days. When the patient has been able to digest solid food, and there is no return of the distinctive symptoms, he should be allowed to go out; but he must for a long time avoid fatigue. A chill will at any time, for months after he has apparently recovered, produce a relapse. Drugs have no effect on the disease, although a slight temporary im-

[1] In a paper by the writer, which has been published in the 75th volume of the *Medico-Chirurgical Transactions*, it is shown by chemical analysis that the whiteness of the motions, which may continue over long periods during convalescence, is not due to absence of bile, and that colourless stools may exist whilst the functions of both the liver and the pancreas are active.

provement may sometimes be seen after the exhibition of a small dose of rhubarb. For a severe diarrhœa with pain, which occurs occasionally, particularly in the relapses, a moderate dose of laudanum is useful, but opium has no curative effect on the malady. The patient should not return to the country where the disease occurs if he can avoid doing so, as experience shows that relapses are common in these circumstances. Where the return is unavoidable, if possible a whole year should be allowed to elapse after complete recovery, before leaving again for the East. Patients who remain at home, and who have made a good recovery, usually enjoy fairly good health; and several patients who were seen by the writer some years ago, suffering severely from this disease, are now able to lead active lives in England, their recovery and good health being completely sustained. G. Thin.

PSOAS ABSCESS.—Synon.: Fr. *Abcès du Psoas*; Ger. *Psoasabscess.*

Definition.—An abscess within the sheath of the psoas muscle, almost always of spinal origin.

Ætiology.—Caries of the lower dorsal or lumbar spine is the cause of psoas abscess, and these being the regions of the spine most commonly diseased, this is the commonest form of spinal abscess. The caries is almost always tubercular. Syphilis and actinomycosis are very rare causes. Rarely, too, an abscess starting from the hip-joint makes its way into the sheath of the psoas, and travels upwards in it, even to a lumbar transverse process, as the writer has seen in a case of pyæmic suppuration in both hip-joints. It is said that a suppurative inflammation may arise within the psoas sheath, unconnected with disease of bone or joint, but supposed to be consequent upon strain or exposure to cold.

Anatomical Characters.—The disease may begin on the surface of one or two vertebræ: a tubercular periostitis results and generally spreads over several bodies (*anterior caries, caries without curvature*), a form occurring chiefly in adults, specially liable to end in abscess, and formerly regarded as exceptionally fatal. An abscess from such a source lifts up the anterior common ligament, and all structures in front of it, such as vessels, pillars of the diaphragm, and so forth; these become matted together in dense fibrous tissue, and form the anterior wall of the abscess cavity. More commonly the disease appears in the body of one or two vertebræ close to an intervertebral disc, because, as is supposed, it is here, at the junction of bone and cartilage, that the slight injuries which so often precede and predispose to tubercular disease take effect. The result of the settlement of bacilli is the formation round about them of an inflammatory infiltration, which may be small and circumscribed or, more rarely, diffused throughout the body of the vertebra as a general osteitis. In either case, as a rule, it tends to spread, making its way towards the surface, usually the antero-lateral: a periostitis is now excited. As the infiltration spreads it caseates and dies in its older portions. The infiltration ordinarily eats away the cancelli, and, under the influence of pressure, the part above the eroded area sinks down on to that below it, and a 'Pott's boss,' or projection of the spines, is thus developed. With a less acute infiltration sclerosis of bone results, and a subsequent exacerbation of the inflammation or caseation of the products will lead to the formation of considerable sequestra of dense bone. Smaller sequestra are frequent, and result from caseation of an infiltration which still contains particles of uneroded bone (*caries necrotica*). Having reached the surface and excited a periostitis, the disease may spread to neighbouring vertebræ, skipping over the discs, and destroying them by eating away the bone on each side of them rather than by direct attack; and as body after body is eroded the curvature increases. The disease may be arrested, and often is so under suitable treatment. But in many cases, especially among the poorer classes, and among adults in all classes, the caseous material 'softens,' *i.e.* becomes mixed up with a quantity of fluid in which the fatty cells and their *débris* float. This mixture constitutes the 'pus' of chronic abscesses; it is thin and watery, quite opaque, pale yellow-white, often contains visible and sometimes large masses of fattily degenerated cells, and bony and calcareous particles may be numerous when the abscess springs from bone. This fluid, as it increases, presses onwards in the direction of least resistance. Starting from the lower dorsal spine, it may pass through the diaphragm with the aorta, but much more commonly it extends laterally beneath the pleura so as to reach the highest digitation of the psoas rising from the lower edge of the twelfth dorsal vertebra. With this slip it passes beneath the internal arched ligament of the diaphragm, and thus enters the sheath of the psoas. Pus from lumbar vertebræ may enter the sheath at once, if the disease reaches the surface at a point from which one of the slips of the psoas arises; otherwise the subperiosteal abscess travels on the front of the spine and extends laterally until, perhaps, it raises one of these slips of origin from the bone and thus enters the sheath. The aperture of communication between the psoas sheath and the cavity in front of the diseased bone is often very small; there may be more than one. Having thus entered the sheath of the muscle, the pus by its constant pressure and irritation causes atrophy of the muscle-cells, and inflammation,

which leads to thickening of the connective tissue into a capsule for the pus; this capsule is lined with a thick layer of very loosely adherent granulation-tissue, which, no doubt, adds its quota to the fluid and solid contents of the cavity. It is speedily infected from the contents, and cheesy points in it are numerous. Crossing the interior of the cavity are more or fewer bands, some containing vessels, others nerves of the lumbar plexus; pain referred to their distribution is therefore not to be wondered at. Pressing on, the pus may so distend the psoas that it will reach out to the anterior iliac spine; but, usually, fluid as far out as this lies beneath the iliac fascia, with which the psoas fascia is continuous on its outer side. An abscess filling the iliac fossa and not passing beneath Poupart's ligament is called an 'iliac abscess;' it is a stage of a psoas abscess. But from the iliac fossa it is said that pus may pass out over the crest through Petit's triangle, which involves its bursting through the strong iliac fascia. This certainly takes place when the pus makes a way to the surface through the muscles of the abdominal wall just internal to the anterior iliac spine. With or without filling the iliac fossa, the pus usually passes down behind Poupart's ligament, lying external to the femoral artery; then, taking the profunda for its guide, it runs inwards beneath the main vessels, over the pectineus and adductor brevis, between the adductors longus and magnus, to the inner side of the thigh. Rarely do we see an abscess of such extent nowadays; but formerly they occasionally ran even down to the internal malleolus. It is common for diverticula to pass from the cavity along branches of the profunda, especially along the internal circumflex, which conducts the pus to the face of the quadratus, and the swelling indicating it presents on the buttock beneath the lower fibres of the gluteus maximus. Besides this, there may be no other perceptible swelling in the thigh; it must not be mistaken for an abscess pointing through the great sacrosciatic notch.

Pus from lumbar vertebræ may pass beneath an arch of origin of the psoas over the side of a vertebra; then, taking the lumbar artery and its posterior division as its guide, the pus runs back internal to the inter-transverse ligament, and issues beneath the latissimus, having escaped from between the erector and quadratus. This is the 'lumbar abscess' of spinal disease. Rarely pus from lumbar caries may run down along the great vessels into the pelvis.

Symptoms.—At first the symptoms are those of spinal disease. If an abscess is forming quickly, and much tension within the muscle-sheath is developed, full extension of the hip causes pain, and persistent flexion is consequently maintained; but in less acute cases there is often no history of pain, lameness, or flexion. There may be pain along the line of one or more branches of the lumbar plexus. Even the ordinary symptoms of spinal disease are not very rarely absent, and a swelling in the groin is the first thing noticed. It often seems to have appeared suddenly; lies external, and perhaps also beneath and internal to the vessels; is smooth, rounded, more or less tense, and more or less fluctuant; is covered by normal skin; is not tender; has a distinct impulse on coughing; and disappears more or less completely in the recumbent position or on pressure. Fluctuation is obtainable between a fulness above Poupart's ligament and the swelling below it. Though the former may be slight, it is generally considerable, and may actually distend the abdomen up to the ribs. Sooner or later, either above or below Poupart's ligament, the abscess points; the skin then reddens, thins, and finally gives way. This may take place with some acuteness.

Diagnosis.—There is no difficulty when the abscess is typical, and spinal disease marked. But a swelling like an iliac or psoas abscess may be present without obvious spinal disease. The probability is that it is of spinal origin, and searching inquiry must be made for occasional pain in the back or in the stomach; for disinclination for active exercise (especially jumping), and early fatigue; for any tendency to use the arms to take off part of the weight of the body from the legs; and for slowness or difficulty in performing such movements as rising from the stooping or sitting posture being noted. The spine should be carefully examined for any slight prominence; and, if any is found, percussion and heat must be employed here to strengthen the suspicion excited.

The surgeon should cause the patient—stripped to the hips—to execute before him all the movements of the spine (bending forwards, backwards, and to each side, and rotation towards each side), and should note whether they are *completely*, *sharply*, and painlessly performed, and if all the spines seem to separate, or whether certain ones retain their distances, indicating that a length of spine is held fixed. But it is not always possible to establish a certain diagnosis, as cases in the writer's experience show.

Failing to find evidence of spinal disease, it becomes necessary to seek for other possible causes of psoas abscess: the hip-joint must be proved healthy, the renal region must be explored, the urinary history gone into, and the urine examined; the possibility of empyema pointing in the groin must be excluded; in case of iliac abscess, abscess from disease of the ilium, perityphlitic abscess, abscesses following on pelvic peritonitis and parametritis, soft rapidly growing

tumours, and serous and hydatid cysts of the iliac fossa, must be thought of.

Prognosis.—In pre-antiseptic days this was grave, and surgeons advised their patients to 'thank God for every day that such an abscess remained closed.' Under present treatment the prognosis is good. Its gravity increases, so far as the abscess is concerned, with the size and number of branches of the abscess, and with the age of the patient. The gravity of the case is greatly increased if the abscess cavity becomes septic; children are much more likely than adults to survive this complication.

Treatment.—*Simple rest* has its advocates, who maintain that under such circumstances these abscesses often dry up. How often this occurs is questionable; when it does, an infective caseous mass is left—a constant source of danger. *Repeated aspiration* may lead to a similar result. In spite of antiseptic precautions (which are most necessary), sooner or later a puncture generally fails to heal, inflames, and a permanent aperture is established—probably owing to infection of the skin as the needle is withdrawn. *Free antiseptic drainage* has yielded good results; but for weeks and months a sinus was kept open, and septic infection was more or less frequent according to the skill and care of those in charge. Further, a quantity of infective material is left when healing results from this treatment. To destroy the infective lining of the cavity, Billroth aspirated or tapped the cavity, washed it out with an antiseptic solution, and finally injected a mixture of glycerine and iodoform, which was left in. In France, after aspiration a solution of iodoform in ether was injected—a method which is both difficult to carry out and painful. By himself and others Billroth's original method has been fully developed; and the writer believes it to be the best at present known. The object in view is to remove as completely as possible the contents and the lining membrane of the cavity.

The danger of this treatment, the details of which will be found in treatises on surgery, is very slight; but at least one case has died (in an unaccountable way) very shortly after operation. The writer thinks that a psoas or iliac abscess should be thus treated as soon as it is discovered. If it is not yet presenting in the groin, it should be opened in the loin through an incision passing outside the erector and through the quadratus on to the psoas, as suggested by Mr. Treves.

Stanley Boyd.

PSORIASIS

PSORIASIS (ψώρα, scurf).—Synon.: Lepra; Alphos; Fr. *Psoriasis*; Ger. *Schuppenflechte*.

Definition.—A chronic inflammatory disease, occurring chiefly on the extensor aspect of the limbs, and consisting of discoid patches with scaly crusts on a red base.

Varieties.—There is really only one kind of psoriasis, but the older writers gave names to the different phases of the disease founded upon (1) the size of the patches, using such qualifying terms as punctata, guttata, nummulata; (2) the extent of the disease—diffusa, universalis; (3) the covering of the patches—rupioides, empyodes; (4) their shape—circinata, gyrata; (5) their duration—inveterata, &c. Scaly syphilides also are often spoken of as syphilitic psoriasis, but modern dermatologists avoid all these artificial and ambiguous varieties, which are of no practical importance and in the syphilides are misnomers.

Ætiology.—Psoriasis attacks equally both sexes and all classes. It is rare before three years of age; on the other hand, it seldom begins after fifty years, but those previously subject to it may go on having it up to any age. It is hereditary in a large number of cases, but not very strongly, as it is not often that more than one or two in a large family are affected. The general health is often quite good, but depressing influences, whether of mind or body, will often determine an attack in those predisposed to the disease. Gout is a predisposing factor in adult life, but only in a small proportion of cases. Spring and winter are the most common seasons for a new outbreak.

Anatomical Characters.—The true pathology of psoriasis is still unknown, but few dispute that the process itself is one of moderate inflammation in the papillary layer of the corium, producing cell-infiltration and vascular dilatation, chiefly round the hair-follicles and sweat-ducts. The layers of the rete are enormously and rapidly increased, especially over the papillæ, but with a great tendency to premature hornification and exfoliation. The papillæ are much enlarged by the down-growth of the interpapillary processes. A few pathologists hold that the change in the rete, which they call 'keratolysis,' is the primary condition, to which the inflammatory phenomena are secondary.

Description.—No part is absolutely exempt from attack, but the disease generally appears first and in its most typical aspect on the extensor surface of the limbs, especially the elbows and knees, and the parts below; and it is often confined to these regions, the flexor aspect being actually free or only affected in a minor degree. Next in order of frequency are the scalp, trunk, the back more than the front, the face comparatively seldom, but more frequently in women and children than in men, while the palms and soles are rarely attacked. The disease is in the main symmetrical in its distribution.

A well-developed patch, which may be from a half to two or three inches in diameter, is well defined at the border, contrasting

sharply with the healthy skin, and consists of a brightly reddened disc more or less concealed by silvery scales adhering into a spongy crust. When this is removed, the under-layer being generally firmly attached, bright red, easily bleeding points are brought into view, which are the tops of the enlarged papillæ. The amount of scaliness varies with the acuteness of the process. When slowly formed, the scales are closely adherent to each other and to the plaque, while in acute cases they flake off too quickly to form crusts, and the intensely hyperæmic base is freely exposed. On the back of the hands and the face the scales get washed off. On the scrotum the natural moisture has the same effect, and there is often fissuring and great irritation. On the palms and soles patches are seldom seen, but the epidermis is dry, thickened, and cracked, imparting a worm-eaten appearance to the part. In the scalp the hair is dry, but seldom comes out much, except in acute cases. The nails are, however, often discoloured, pitted, furrowed, and brittle.

Development and Course.—Each lesion begins as a pin's head sized papule, surmounted almost from the first by a scaly cap; this speedily enlarges to a small disc, which continues to spread peripherally until a patch of two or three inches diameter may be formed. Larger areas are produced by coalescence of adjoining patches; but, however extensive they may be, there are always some areas of healthy skin. When regression takes place it commences in the centre, and when this is clear a circle is formed, or, if the patches have previously coalesced, a gyrate contour. Occasionally, however, on the trunk gyrate and circinate patches are primarily formed from the disease attacking the hair-follicles only, and following therefore their arrangement; this is the lepra of Willan. As further absorption occurs the circular border is broken up, and ultimately the fragments also disappear, leaving a transitory red stain, or a long-lasting yellowish-brown one when the disease has been treated for some time with arsenic. Itching varies much: it may be absent, or very slight, but as a rule is present in a moderate degree, and is only rarely as intense as in eczema.

Diagnosis.—The characteristic features of psoriasis are the position of the patches chiefly on the extensor aspect of the limbs, and especially on the elbows and knees; the borders of the patches being well-defined; the scales being white and adherent into crusts, but without inflammatory exudation. When the crusts are removed, bright red, easily bleeding points are visible. The presence of all these features renders the diagnosis inevitable. Lichen planus, eczema, pityriasis rubra, tinea circinata, and squamous syphilides in some phases, are the diseases most likely to be mistaken for psoriasis.

The patches of lichen planus are roundish, well-defined, and scaly, but they do not choose the special seats of psoriasis; the scales are scanty compared to psoriasis; the colour is violet red instead of bright red. They leave deep pigmentation behind them, and there are almost always some of the characteristic flat papules in the neighbourhood of the patch. Scaly patches of eczema are seldom defined at the borders; the scales are in a single layer or mixed with inflammatory exudation, or there may be a history of discharge; there are no bright red points when the scales are removed; while eczema is much more common on the flexor than the extensor surface of the limbs, and even on the extensor aspect does not specially choose the elbows and knees. In pityriasis rubra, confusion could only arise before the disease became truly universal, which psoriasis never does. Pityriasis rubra is diffuse, not in patches; the border is less defined; the colour is an intense bright red; the scales are large, thin, and papery, do not conceal the ground colour, never adhere into crusts nor ever their whole surface, and are thrown off almost as rapidly as they are formed. It must be remembered that pityriasis rubra sometimes develops from a pre-existing psoriasis, but the change is usually acute, and there will be a history of previous chronic patches.

In tinea circinata, the small number of non-symmetrical patches coming in any part of the body, the very scanty scales and the at first papular border, ought to lead to microscopic examination of the scales for the fungus, if a positive conclusion cannot be arrived at without it.

Secondary scaly syphilides are rarely acquired before adult age, while psoriasis is a common disease of childhood; on the other hand, psoriasis is rare under three years, and does not therefore clash with congenital syphilides. The scaly syphilide is in small patches, with scanty, dirty-looking scales on a dull red base; does not specially affect the extensor aspect of the limbs; is often associated with other forms of eruption; leaves fawn-coloured pigmentation behind; and is nearly always accompanied by the other symptoms of syphilis. In the circinate scaly syphilide the same distinctions in position, colour, scales, and concomitant symptoms hold good. In the tertiary scaly syphilide the resemblance may be rather close, but position will again assist: the face is often affected; the number of patches is usually small; they are not symmetrically arranged; the edge is more raised, the centre more depressed; ulceration is common; and scarring and pigmentation follow the disappearance of the lesion.

Prognosis.—It is always possible, but often difficult, to remove the lesions of any one attack, but recurrence at some time or other

takes place in 90 per cent. of cases, the interval of freedom varying from weeks to years. Sometimes psoriasis disappears spontaneously, but more often continues for years with remissions and exacerbations, which may at any time assume a severe form with widespread distribution.

TREATMENT.—Combined external and internal treatment is the most rapidly efficacious method of removing the eruption of psoriasis, cases of moderate extent requiring from three weeks to three months. The general health being in a majority of cases undisturbed, specifics find their most fitting opportunity, of which arsenic claims the first place. The soundest principle, however, is to carefully search for any departure from the highest standard of health, and to endeavour to rectify it, if found, before resorting to the routine treatment with arsenic.

Conditions depressing vitality are the most common: overwork, anxiety, suckling, or any prolonged drain upon the system may be determining factors. Gout and rheumatism take a more subordinate place, but if present require appropriate treatment; and only when these difficulties have been removed or met should arsenic be called in. This drug may be given in either a solid or liquid form; and although practitioners have their fancies for this or that salt, practically arsenious acid for pills, and Fowler's solution for mixtures, meet all requirements.

The solid form is often the most convenient, as it interferes least with the patient's avocations. The following are useful formulæ: Arsenious acid one grain, extract of hop ʒj.; mix thoroughly, and divide into 30 pills. Take one three times a day after meals. The well-known Asiatic pills are stronger, containing nearly $\frac{1}{12}$ of a grain of arsenic in each, and are much used abroad: Arsenious acid 66 grains, powdered black pepper ʒix.; gum arabic and water a sufficiency; mix, and divide into 800 pills. Take one three times a day after meals. When the patient is tolerant, and the disease obstinate, the dose may be increased until the limit of his endurance is reached, griping and diarrhœa being obviated by combining opium; of course, the effect on the patient as well as on the disease should be watched. But while the pills will always hold a place on account of their convenience, where practicable Fowler's solution is preferable, as it can be freely diluted, and the irritant effect on the stomach more likely to be avoided. Beginning with 3 to 5 minims, it may be pushed up to 10 or 12 minims or more, three times a day, always after meals.

Improvement is not manifested at once; often the full physiological effects of the drug must be reached before the scales cease to form; then the older ones drop off, the patch begins to clear, first in the centre and then gradually over its whole area. Arsenic is contra-indicated when the eruption is very hyperæmic, or is coming out acutely, or when there is acute or chronic irritability of the alimentary canal. It will often make acute cases spread faster, and increase the itching very considerably. Even in suitable cases, however, this increased itching may also be excited at first; but it subsides in a week or two, and the patches begin to clear up.

The local treatment consists in removing the scales by alkaline baths or soft soap, and then rubbing in stimulating and antiseptic applications, in the form either of lotions, liniments, or ointments. The local applications may be placed in three divisions, in the grade of their stimulating effect, although that probably is not their sole mode of action, as they are all more or less antiseptic. In the first division may be placed the mercurial preparations, of which the ammonio-chloride, the nitrate, and the yellow oxide are chiefly employed; either may be used as an ointment, in the proportion of ʒj. to the ℥j. of lard or other base. They should not be used over a very large area, nor be rubbed in night and morning continuously. This applies to all stimulating methods of treatment. In the next division come the tarry preparations, naphthol, and thymol. Preparations of tar have long been the classical treatment for psoriasis. They are very numerous, but oil of cade and oleum rusci pyroligneum or birch-tar oil are the least objectionable for ointments or liniments, and are used in various strengths from ♏x. to ʒij. to the ℥j., or even stronger. For a lotion the alcoholic solution called liquor carbonis detergens, from ℥ss. to ℥ij. to ℥viij. of water, sponged freely over three times a day, is often very useful. β-Naphthol and thymol are generally used as ointments: ʒj. to the ℥j. is an average strength, the addition of ʒj. of prepared chalk facilitating the preparation of the ointment. They have the advantage of being cleanly and free from disagreeable odour. In the third division are the strongest stimulants, such as turpentine, pyrogallic acid, and chrysarobin. Turpentine is used as a liniment from 1 to 4 up to equal parts of it and olive oil. Pyrogallic acid and chrysarobin may be used as ointments, gr. xx. to ʒj. to the ℥j. Pyrogallic acid stains linen, and dangerous absorption may ensue if used over a large surface. Chrysarobin also stains both skin, hair, and linen, and may excite an erythema with œdema resembling erysipelas; it soon passes off when the drug is stopped. In suitable cases it is the most rapidly efficacious of all local remedies. These are only a tithe of the remedies suggested for this obstinate disease, and they may be combined in endless variety and strength. The guide in the selection of a remedy is the amount of hyperæmia present in the patches. The more acute the process, the less stimulation is required; and if very acute, soothing appli-

cations, such as olive oil, simple or combined with calamine and oxide of zinc and lime water, may be bandaged on continuously. The patient's circumstances and occupation, as well as the position of the eruption, are also to be taken into account in choosing the remedy and mode of applying it, and considerable experience is requisite to form a correct judgment on all these points.

H. RADCLIFFE CROCKER.

PSOROSPERMIA.—This term was applied by J. Müller in 1841 to a parasitic affection of the skin, muscles, kidneys, and bladders of fish and frogs. It is derived from the Greek *ψώρα* or *ψώρη*, signifying a cutaneous disease, itch, scab, or mange. The French use the word *psore* as a generic title for vesicular and pustular maladies of the skin.

The term 'psorospermosis' is applied to lesions in the human subject characterised by the presence of minute cysts or saccules containing bodies, in shape and structure similar to the *coccidium oviforme*, which frequents the bile-ducts of rabbits.

In 1858, Gubler (*Mém. Soc. Bio.* 1858) recorded the case of a man forty-five years old who suffered from disordered digestion and anæmia; the liver was enlarged, and a spherical tumour could be made out in the neighbourhood of the gall-bladder. The anæmia increased; violent pains occurred in the body, accompanied by fever, vomiting, collapse, and delirium; and the case terminated in death. The liver contained twenty tumours, some of the size of chestnuts, others as big as eggs, in addition to the large tumour felt during life. These encapsuled tumours contained thick fluid and countless egg-like bodies, which were regarded as the ova of *distoma lanceolatum.* Leuckart has since pointed out that these bodies were coccidia.

Similar cases have been reported in Germany. In 1883, Dr. Hadden exhibited before the Pathological Society of London some of the viscera of a gentleman, thirty-eight years of age, who died after fourteen days' illness. The chief symptoms were drowsiness and fever, followed by low muttering delirium and partial unconsciousness, and ending in death. The parietal layer of the pericardium, muscular tissue of the heart, parietal layers of the pleuræ, omentum, capsule of liver and spleen, kidneys and convex surface of the brain, were dotted with minute nodules. Some of the nodules were submitted to Cobbold, who pronounced them to be psorospermial sacs.

Subsequently, several examples of this disease have been brought before the Pathological Society of London, from which it would appear that psorospermosis in man has a great tendency to attack the kidneys and ureters. Psorosperm saccules occur in the mucous membrane of the ureter as nodules of the size of hemp-seed; these sometimes aggregate in clusters near the vesical orifice of the ureter, and give rise to hydronephrosis. When a saccule is suitably prepared and cut for the microscope, it will be found to contain oval bodies as in fig. 122.

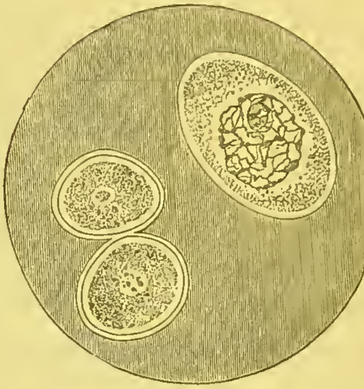

FIG. 122.—Three Psorosperms (two shown in section) from a Ureter. (Leitz, obj. $\frac{1}{20}$ in., Zeiss, oc. 2.) (After J. J. Clarke.)

In the few cases of psorospermosis of the urinary organs of which the clinical histories are forthcoming, it would appear that the disease runs a rapid course (two to three weeks), and gives rise to hæmaturia, anæmia, frequent micturition, and death. So far all the cases have occurred in adults, and the disease attacks women and men equally.

In addition to the viscera, psorospermial bodies occur in the skin. In 1889, Darier made a communication to the Société de Biologie to the effect that these bodies are present in the disease known as chronic eczema of the nipple. This observation was fully confirmed by Wickham (*Arch. de Méd. Expérimentale*, January 1890), and in this country by J. Hutchinson, jun. (*Trans. Path. Soc.*, vol. xli. p. 214). These researches would appear to decide the much debated question of the cause of chronic eczema of the nipple. As this disease is known to be followed in a large proportion of cases by mammary cancer, it naturally followed that the presence of these bodies in cancerous lesions would be suspected, and attempts have already been made to connect psorosperms with mammary cancer; as yet the evidence is far from convincing.

Although most of the observers who have devoted attention to psorospermosis hold the opinion that the gregarine-like bodies found in the saccules met with in man are similar to the coccidia of rabbits, yet there are differences in size and other features, indicating at least specific distinction; there are also slight differences in psorosperm bodies associated with chronic eczema of the nipple and those which are found in the viscera.

Up to the present time we are ignorant

of the origin and development of coccidia and psorosperm bodies in general, nor have we any knowledge of the mode by which they gain entrance into the body. So far all attempts to cultivate them artificially have failed.

J. Bland Sutton.

PSYCHOSIS.—*See* Sycosis.

PSYDRACIUM (dim. of ψύδρακες, blisters).—A small blister, or pustule, without inflammatory base; a cold pustule, in contradistinction to *phlyzacium* or hot pustule.

PTOMAÏNES (πτῶμα, a dead body).—Synon.: Cadaveric Alkaloids; Fr. *Ptomaïnes.* Ptomaïnes are alkaloids produced by the decomposition of animal substances. The word *ptomaïne* was at first restricted to alkaloids produced by cadaveric decomposition, but it is now also employed to designate alkaloids of animal origin formed during life, as a result of chemical changes induced by some agency or other acting within the organism. The term *leucomaïne* has been introduced to particularise the animal alkaloids formed during life from those produced by decomposition of dead animal matter; but it would be preferable for the terms *ptomaïnes* and *leucomaïnes* to be abandoned, and to class these bases of animal origin in one category as *animal alkaloids.*

History.—It is now known that the power of manufacturing alkaloids is not restricted to plants, but is shared by animal organisms. In 1822 Gaspard and Stick extracted a venomous principle from corpses. In 1856 Panum detected a very active poison in putrid matter. In 1866 Dupré and Bence-Jones found an alkaloidal substance, resembling quinine in some of its properties, in the liver. In 1868 Bergmann and Schmiedeberg obtained from putrid beer a nitrogenous crystalline substance, which they called *sepsine*, and which was subsequently thought to be discovered in septicæmic blood. In 1871 Selmi, examining the dead body of a person supposed to have been poisoned, extracted an alkaloid which he was unable to identify with any known body, and was led to suspect that it had been produced after death; and in 1877 the same observer, by subjecting pure albumen to putrefaction, produced and separated two new alkaloids. Since then Gautier and Brieger have made extensive researches, resulting in the discovery of several animal alkaloids.

Creatinine, discovered in urine by Liebig and Pettenkofer, was the first body of animal origin acknowledged to be an alkaloid. Later on, Liebrich detected the already known vegetable alkaloid betaine in normal urine. In 1880 Pouchet detected carnine in the urine of man; and this was confirmed in 1881 by Gautier, who showed that it possessed the general properties of a ptomaïne. In 1882 Bouchard demonstrated that not only were alkaloids present in appreciable quantities in normal urines, but that they augmented notably in the course of certain maladies—typhoid fever, for instance; and, later, Lepine and Aubert concluded that these alkaloids in the urine increase in quantity until the crisis of the disease is reached, after which they diminish.

Ptomaïnes of known composition.—The common ancestor of alkaloids, whether animal or vegetable, is albumin, the complex albumin molecule being split up, either by bacterial agency or otherwise, into several less complex molecules, among which are the animal alkaloids. The following is a list of the principal ptomaïnes that have been extracted from putrefying animal matters, and submitted to ultimate analysis:—

Collodine, $C_8H_{11}N$, from putrefying horseflesh and mackerel.

Parvoline, $C_9H_{13}N$, from putrefying horseflesh and mackerel.

Unnamed base, $C_{10}H_{15}N$, from putrefying fibrin of bullock's blood.

Hydro-collodine, $C_8H_{13}N$, from putrefying horseflesh and mackerel.

Putrescine, $C_4H_{12}N_2$, from human corpses.

Neuridine, $C_5H_{14}N_2$, from human corpses, and from putrefying fish and cheese.

Cadaverine, $C_5H_{16}N_2$, from human corpses.

Neurine, $C_5H_{13}NO$, from cadaveric putrefaction.

Choline, $C_5H_{15}NO_2$, from cadaveric putrefaction.

Muscarine, $C_5H_{13}NO_2$, from putrid fish.

Gadinine, $C_7H_{16}NO_2$, from putrid cod-fish.

Tyrotoxicon (diazobenzene butyrate), from decomposing cheese, milk, and cream.

Animal alkaloids are also a necessary product of vital physiological processes, and have been extracted from the secretions of living beings, and from fresh animal tissues. The following is a list of the principal animal alkaloids so obtained:—

Creatinine, $C_4H_7N_3O$, from urine.

Pseudo-xanthine, $C_4H_5N_5O$, from urine and flesh.

Sarkine, $C_5H_4N_4O$, from urine and flesh.

Xanthine, $C_5H_4N_4O_2$, from urine and flesh.

Crusocreatinine, $C_5H_8N_4O$, from fresh meat.

Xanthocreatinine, $C_5H_{10}N_4O$, from fresh meat.

Guanine, $C_5H_5N_5O$, from flesh and guano.

Carnine, $C_7H_8N_4O_3$, from fresh meat.

Betaine, $C_5H_{11}NO_2$, from urine.

Mytilotoxine, $C_6H_{15}NO_2$, from poisonous mussels.

Ptomaïnes and Disease.—Animal alkaloids are being incessantly produced within our bodies as a result of the normal physiological processes, and they are eliminated by the bowels, kidneys, liver, skin, and lungs; but

if from any cause these eliminating organs fail to perfectly fulfil their excretory functions, then an accumulation of theso alkaloids in the system occurs, and a toxic action is exerted by them on the nervous centres. In this way can be explained the headache resulting from constipation, and the more serious nervous symptoms resulting from deficient excretory action of the kidneys in certain diseases of those organs. The removal of these animal alkaloids is, however, not only effected by the excretory organs, but, in addition, a powerful agent for their destruction is at work in the oxygen of the blood, which is continually oxidising and burning them up; and it seems probable that this combustion to a large extent occurs in the liver. If, the excretory organs remaining sound, there is excessive production of animal alkaloids, but inadequate elimination and destruction—a condition which is obtained in all forms of over-exertion, as in a prolonged march—then accumulation of material elaborated in excess and imperfectly eliminated or destroyed occurs, and an auto-infection, a temporary poisoning of the system, results, the poison affecting the nervous centres, and producing the fever of over-exertion, the fever of prostration.

As regards the infectious fevers, it is probable that after the admission of the specific micro-organisms into the body, and provided they find the conditions suitable, they live and multiply, and that, as a result or a residuum of their vital activity, a powerful alkaloidal or other poison is produced, the toxicity of which is the cause of the symptoms of the disease. If so, each infectious fever is the result of a fermentative decomposition of albuminous matter within the body, induced by a special micro-organism, manufacturing its own peculiar poison for each disease. The following is a brief *résumé* of the work that has been done in support of this view:—

Pouchet has extracted from the fæces of a cholera patient an alkaloidal body, which, injected into animals, produces slowing of the heart and, later, death, followed quickly by *rigor mortis*. Pouchet, Nicati, and Rietsch have obtained from cultivations of Koch's cholera bacillus traces of an alkaloid which appeared to be identical with the preceding one. From cultivations of the typhoid bacillus Brieger obtained a small quantity of a poisonous alkaloid which he named *typhotoxine*. From the abdominal and thoracic organs of a patient who died from typhoid fever, during the third week of the attack, Dr. Dixon Mann extracted a small quantity of an alkaloid, which gave all the reactions of a ptomaïne; and from the organs of a patient dying of septicæmia, of unknown origin, Dr. Dixon Mann also extracted a small quantity of a ptomaïne. The writer has extracted small quantities of a ptomaïne from the urine of typhoid-fever patients; and also another ptomaïne from the urine of scarlet-fever patients. These ptomaïnes are present in the urine during the height of the fever, and disappear as the fever declines. Griffiths has found a ptomaïne in the urine of a case of mumps. From the urine of a case of pernicious anæmia Dr. William Hunter extracted three ptomaïnes—one identical with putrescine, another identical with cadaverine, and a third which is probably a new diamine compound. Bourget isolated several ptomaïnes from the viscera of a woman who died of puerperal fever; and from the urine of patients suffering from this disease he obtained similar bases. Udransky and Baumann detected the ptomaïnes cadaverine and putrescine in a case of cystinuria. Brieger, from cultivations of the tetanus bacillus, extracted four ptomaïnes, all of which when injected into mice produced tetanus. In addition to the diseases mentioned, it seems probable that in many non-contagious diseases abnormal chemical changes may take place, independent of bacterial agency, and may result in the formation of poisons which exert a toxic influence on the organism within which they are produced. The toxic agent of expired air is probably a volatile ptomaïne, or mixture of ptomaïnes.

The chief medico-legal interest attaching to the ptomaïnes arises from their liability to be confounded with some of the vegetable alkaloids, and hence to the possibility of their leading to mistakes in medico-legal practice. There are no chemical reactions by which the ptomaïnes as a class may be distinguished from the vegetable alkaloids.

For a description of ptomaïnes in connexion with food poisoning, *see* Poisonous Food.

Arthur P. Luff.

PTOSIS (πτῶσις, a fall).—A drooping or falling of the upper eyelid, with inability to raise it, due to paralysis of the third cranial nerve. *See* Third Nerve, Diseases of.

PTYALISM (πτύαλον, saliva).—A synonym for salivation, or excessive flow of saliva. *See* Salivary Secretion, Disorders of.

PUBERTY, Disorders of.—Synon.: Fr. *Troubles de la Puberté*; Ger. *Störungen der Pubertät.*

Of the various periods into which existence is divisible, certainly not the least important, in its pathological aspect, is that intervening between childhood and maturity, when the reproductive powers become developed, and which is known as *puberty*.

This epoch occurs earlier in warm climates, sanguine temperaments, and highly cultivated and luxurious states of society; it is retarded by the opposite conditions. In these islands

it generally commences between the ages of thirteen and fifteen in females, and a year later in males. Under the age of fourteen, a male is legally supposed incapable of committing a rape; and a female under sixteen is held to be incapable of consenting to sexual intercourse. By the Roman law, the period of the commencement of puberty was identical with that at which the individual became liable to military duty. Thus Hadrian commenced his service at the age of fifteen.

Puberty cannot, however, be estimated by age alone. Even in this climate, the period of the commencement of puberty varies widely. The writer has seen instances of menstruation in children under ten, and has assisted at the delivery of a girl of fourteen years of age. More frequently, however, puberty is postponed beyond the ordinary period, which may be also modified by family or hereditary peculiarities, and the influence of various diseases.

In the first stages of life, the functional differences between the sexes are comparatively slightly marked; but on the approach of puberty these suddenly become prominent, and so obvious does the influence of the uterine system become, that *propter uterum est mulier* is then almost literally the case.

The accession of puberty in the male is attended by a characteristic alteration of the voice, from 'the thin childish treble' to 'the deep manly bass,' owing to the development of the *pomum Adami*, and the elongation of the thyroid cartilage and thyro-arytænoid muscles. About the same time occurs growth of hair on the face, pubes, and other parts of the body. Before this there are observed the development of the male genital organs, the enlargement of the testes and other parts of the sexual apparatus, the secretion of the seminal and other accessory fluids, and the first outburst of the sexual instincts and feelings. So slowly do the successive changes proceed, which mark the occurrence of puberty in the male, that they are not completed until full age has been passed.

In the female, on the contrary, when puberty is reached, the individual passes at a bound, as it were, from childhood to womanhood, although the structural and functional changes involved in the transition are infinitely more complex and important than is the case in the other sex. Thus the enlargement of the external genital organs is accompanied with a still greater change of the internal organs of generation—the development of the uterus, ovaries, and mammæ, and the commencement of that periodic sanguineous discharge *per vaginam*, the recurrence of which at regular monthly intervals marks the period within which woman is capable of reproduction.

The writer has found it less easy to discover the true date of first menstruation than have some authorities whose tables are generally relied upon. In the great majority of cases the statements of those questioned were so indefinite as to be practically valueless, whilst in only 497 instances did he get any approach to accurate data on this point; and in these the mean age of the commencement of that epoch was the sixteenth year. Excluding all cases of so-called infantile menstruation, the results of these inquiries may be thus summarised:—

Under	12	years	of age	4	menstruated	for	first	time
At	12	"	"	17	"	"	"	"
"	13	"	"	50	"	"	"	"
"	14	"	"	94	"	"	"	"
"	15	"	"	138	"	"	"	"
"	16	"	"	105	"	"	"	"
"	17	"	"	65	"	"	"	"
"	18	"	"	10	"	"	"	"
Over	18	"	"	14	"	"	"	"

Generally speaking, therefore, between the ages of thirteen and fifteen in our climate, the human female undergoes the change from childhood to puberty; the essential characteristic of this change consisting in a periodic sanguineous discharge *per vaginam*, resulting from ovulation.[1] The process of menstruation is invariably productive of more or less general constitutional disturbance and mental irritation from its commencement in ovarian hyperæmia, and the maturation and rupture of a Graafian follicle resulting in the discharge of an ovum, its transmission along the Fallopian tube, its transit through the congested uterus, its expulsion thence, together with the disintegrated endo-uterine mucous membrane, or of its epithelium only, and a consequent hæmorrhagic exudation from the denuded uterus, varying in amount, under normal circumstances, from four to eight ounces, and the discharge of which extends over a period of from three to five days at each recurrent monthly epoch. Hence no woman can be properly said to enjoy perfectly the *mens sana in corpore sano* whilst menstruating. When this function has become regularly established, the accompanying constitutional disturbance may be so slight as to be practically unrecognisable. But on the first occurrence of ovulation,

[1] The connexion between ovarian action, or ovulation, and uterine denudation, with menstruation, as described in the above paragraph, was up to a recent period almost universally admitted. Within the past few years, however, some doubt has been thrown on the accuracy of this doctrine by the researches of Mr. Lawson Tait, Drs. Engelman of St. Louis, A. Johnstone, Mr. Bland Sutton, and other authorities. Thus, as the result of his large experience of the pathology and surgery of the uterine appendages, Mr. Tait, speaking of the causation of menstruation, says: 'In fact, the ovaries have nothing to do with it at all; and the (Fallopian) tube has this at least—it is the subject in which the initial phases of the phenomena occur.' Nevertheless, as this question is far too wide for adequate discussion in the present article, and is still *sub judice*, the writer has not thought it necessary to modify materially his previous account of the function of menstruation, to which he still adheres.

few, if any, escape some sympathetic constitutional derangement, and more especially one or other of the protean forms of hysteria. Hence, under the guise of nearly every disease that may affect a girl at the age of puberty, whether it be spinal, cardiac, pulmonary, or any other disorder, the practitioner must look carefully that he has not to deal with some variety of hysteria, directly resulting from the complex process, affecting the ovaries, Fallopian tubes, and uterus, by which puberty is accompanied.

Undue importance is attached to the non-appearance of menstruation, as the supposed cause of all the ills that female flesh is heir to. In the majority of cases of delayed menstruation the amenorrhœa is the result of some constitutional disease or general condition, to the rational treatment of which, and not to any utero-ovarian stimulation, should the efforts of the physician be directed. At the same time, the part played by the development of the reproductive system in either sex, in the transformation from childhood to maturity, is unquestionably of the first importance. The morbid influence of the premature indulgence of the newly awakened sexual appetites at the age of puberty, and the many forms of disease by which the vice of masturbation is avenged by outraged nature, are subjects the medical importance of which it would be difficult to exaggerate, and which it would be impossible to discuss in this article.

Many of the ailments common about the period of puberty are but accompaniments or forerunners of the functional and organic changes then commencing. More especially is this the case in the female sex. Hence the physician must bear in mind that the headaches, palpitations, symptoms of disordered nervous action, and many of the cases of hæmorrhage from various organs at that epoch, which create so much alarm, are, as Sir Henry Holland long since observed, but evidences of 'new balances struck in the allotment of the blood to different parts; and in the course of such changes, congestions and discharges are prone to occur, the latter relieving or preventing the former.' It is hardly necessary to point out the necessity for careful diagnosis between symptoms thus caused, and the evidences of actual disease; for in the former, the active treatment required by the latter would be not only unnecessary, but positively injurious, by interfering with the progress of those natural functional or organic changes on the establishment of which these symptoms will cease. The circulation is now vigorous; not only is the amount of blood in circulation greater during this period, but also its relative proportions of fibrin and red corpuscles are larger, and hence the roseate hues and plump outlines of early youth.

It is therefore not surprising how well young persons at this period bear hæmorrhagic discharges, with which, when due to menstrual causes, the experienced physician will be slow to interfere, lest by their arrest he may bring on more serious consequences. Many of those cases of hæmoptysis which excite so much alarm, as supposed evidences of pulmonary disease, and the subsidence of which is ascribed to the particular treatment adopted, as well as not a few cases of hæmatemesis occurring in girls about this epoch, are merely symptomatic of the changes consequent on puberty, and require little in the way of repressive treatment.

There are few practical subjects more neglected by physicians than the moral, hygienic, and physical management of puberty. The effect of the evolution of puberty, as the occasional exciting cause of insanity, has been briefly alluded to by Dr. Maudsley and some other writers on mental disease. The influence of excessive mental stimulatiou during puberty, as an occasion of the increasing proportion of nervous and cerebral disorders now observable, is a subject, however, deserving of more consideration than it has yet received. At that period of life the present cramming system of education frequently predisposes to insanity, the organ of the mind being goaded into premature activity, and overstrained in the effort to pass some competitive or other examination, deemed essential to entrance on official, commercial, or professional life. Thus the mental powers are worn out and exhausted before they have attained their perfection. In other respects also the prevailing educational system is hurtful to the mind; for nowadays, when education is too often divested of that moral restraint and control formerly held to be essential, 'it proves injurious,' as Dr. Copland foretold would be the case, by giving rise to forced, unnatural, overreaching ambitions, and unprincipled states of society; and these states, in proportion as they are developed, are the parents of crime, insanity, and suicide.

THOMAS MORE MADDEN.

PUBLIC HEALTH.[1]—Such care as communities took for the protection of their health was in early times taken under the auspices of religion or morality; it was hardly until the present century that attempts were made, as matters medical, to understand the conditions for health and disease among communities. Although many

[1] This articlo will deal with medical considerations respecting health and disease in communities. In its plan it will follow Dr. Parkes's article in the original issue, but matters of *Sanitary Law* and the application of *Vital Statistics* will be relegated to separate articlos. *Bacteriology*, and many other subjects which have concorn for individual as much as for public health, are treated under their several headings.—G. B.

old statutes and provisions of the common law may be shown to have their bearing upon public health, organised legislation in England for the promotion of this object may be said to date from the Public Health Act, 1848. The country had by this time, under the system of registration inaugurated in 1837, and by the aid of Royal Commissions, learned something about the causes of death in the population. It had been discovered that year after year far more lives were being forfeited to home-grown epidemics than had been lost during the foreign epidemic of 1831–32. By 1848, the threat of fresh invasion by Asiatic cholera had become near and loud. The time for sanitary action was auspicious. It had come to be seen that communities, as such, had duties towards their members and towards other communities, in respect of matters affecting health; and with this enlarged sense of public responsibility it was felt that adequate organisations should be provided, in order to instruct, direct, and even coerce ignorant or wilful members of each community. Needless to say, this function of legislation speedily asserted itself more definitely and in fresh directions; until the present system of sanitary observation and administration has grown up.

Considering, first, the area of a country in its broader aspects, and always with more particular reference to England and the public-health arrangements of England, we note the influences exerted by the *condition of open lands, forests, and rivers.* The drainage of land, so as to carry off water readily and thus to make both ground and air drier, has a great effect on public health. Ague, so common formerly in England, has greatly lessened; and dysentery, which so often went with it, has in consequence of drainage almost disappeared.

The movements of the ground-water which, by its rises and falls, influence the moisture and the amount of air in the soil, and, through these conditions, alter the amount and rapidity of decomposition therein, have been supposed also to influence health, and to be especially connected with the development of typhoid fever and of cholera. A moist ground is also believed, on tolerably strong evidence, to be favourable to the production of destructive lung-diseases; and there is no doubt that rheumatism and catarrhal affections are more common on damp soils. Although the influence of the ground-water in cholera is questionable, and it is not always active in the production of typhoid fever, it is certain that lowering the level of the ground-water when it is near the surface is often followed by the best results on the general health of the people, and in hot countries malarious diseases have been greatly diminished, even when the lowering of the ground-water has not exceeded a few inches. Recently a noteworthy relation has been observed between the autumnal diarrhœa of children in towns and the earth-temperature under certain circumstances of ground-water.

The regulation of irrigation operations also has become an important matter for systematic study and, if sewage irrigation farms continue to increase in number, for regulation by the State. These farms should not be situated near to houses (not within five hundred yards if possible), and the lands should be properly prepared and drained so that there is no stagnancy of the water. If properly arranged, it seems clear that sewage irrigation farms are not hurtful to the health of their neighbours; but their proper relation to streams that may have to supply an adjacent population with drinking-water still remains in question.

The regulation of forests ought to be considered a State matter, as the climate of a country and, therefore, health are greatly influenced by them. The removal of forests produces a variety of direct effects. Greater movement of air over the earth is permitted; the soil is rendered hotter in all temperate and hot countries, colder in northern lands; the air is drier everywhere, because the rainfall is lessened, the ground is drier, and the evaporation from leaves is lessened; the ground is drier, because there is not only less rain but freer evaporation, and the roots of the trees no longer obstruct the movement of the ground-water, which flows off more rapidly. These direct effects have a varying sanitary significance, according to circumstances: for example, increased movement of air may be injurious, if malarious air be no longer kept away from a town, as is supposed to be the case with the Roman Campagna; again, in hilly countries where the trees have been too much cleared off, there occurs aridity of soil as a rule, and greater rapidity in the amount of water passing into rivers during rains, and thus leading to floods. In this island the regulation of forests is not a matter of much national importance: it is otherwise in Germany and France, where laws exist which restrain private action; and in Italy, Greece, and Turkey the condition of the forests requires grave consideration as a matter of public health, as well as of climate and rainfall. In India this is also the case, and there are several important sanitary aspects under which the operations of the Forest Department need to be regarded.

The regulation of rivers, such as the embankments, narrowings, deepenings, and removal of obstructions, has generally been concerned with little else than navigation or the prevention of accumulations; but rivers are equally important as they may influence the outflow of the land-water from their drainage areas, and in that way may affect the dryness of the soil. In this regard the

condition of all watercourses is a matter of importance, and seems obviously a case for State control. It is not, however, usually included in the subjects of public health; and when any large watercourse is out of order, and inundations from the river or from the sea are dreaded, the Crown usually appoints, on the application of the proprietors of the adjoining lands, a Commission of Sewers, or a Drainage Board, under the Land Drainage Act, to consider what should be done.

In another way the regulation of rivers is of importance. They supply the drinking-water of the community to a large extent, and freedom from contamination is, therefore, necessary. For years this has been seen to form one of the most difficult questions of public health, and for some years a Royal Commission was engaged in inquiring into the causes and remedies of the pollution of rivers. A new Commission has recently presented its Report in special relation to supplies of drinking-water for London. The chief causes of contamination are the dirty water and sewage coming from towns, and the refuse of trade operations. The former can in some measure be met by irrigation or by filtration through land, though the immense quantity of water to be purified, and the price or position of land, may cause difficulty. The admixture of trade refuse-water presents, however, the greater difficulty; yet to prohibit the flow into streams would sometimes be to prohibit the trade works. At present there is no settled standard of purity for either town or trade water before its discharge into streams. Such standards were suggested by the Rivers Pollution Prevention Commissioners, but they have never been accepted either by Parliament or the public, and it is probable that for actual working the standard must vary with the place and trade, and must depend first on the demands made upon the river for drinking use; and, for the rest, on the purity of the river water into which the dirty effluent is discharged, and the comparative volumes of dirty and clean water thus mixed together—*i.e.* upon the extent of the dilution of the impure with the pure water. The number and kind of fish living in the river water are also to be taken into account, effluents of the highest obtainable purity only being admitted into trout or salmon rivers. Thus it will be seen that, at present, little progress has been made in the prevention of the pollution of rivers in England, the interests involved in the continuance of tho pollutod condition of streams being exceedingly strong, and the enforcement of tho law being in the hands of authorities who are often the greatest offenders against its provisions. The new County Councils, however, have been empoworod to enforce its provisions, and much is hoped for from the action of these bodics, who will to a great extent be free from the trammels of petty and local interests.

Of conditions operative upon the health of the individual and of the community, the one that falls most conspicuously within the province of *Local Sanitary Authorities*, as of the Legislature which created them, is the condition under which people havo their dwelling—the state and circumstances of their *habitation*, both in the particular and in the aggregate. So true is this, and so strongly is this consideration felt in practice, that, for the rest, it will be convenient to arrange the subject-matters of the present article with the notion of condition of habitation in the foreground; and to regard each subject as it principally concerns communities inhabiting a larger or smaller place, or as it concerns the particular habitation. Thus, the general subject of public health will, with little exception, be here discussed with reference, first, to collections of houses forming cities, towns, and villages;[1] secondly, to separate houses.

Cities, Towns, and Villages.—The health of the inhabitants of English towns, as judged of by the annual rate of mortality, is not so good as that of the people of rural districts. The mean annual mortality at the present time differs in different towns from 16 or 17 to 29 and 30 per 1,000 of population, while during certain periods it may be much more. In rural districts the mortality is from 12 to 19 or 20 per 1,000.

—	Death-rate per 1,000	
	Town Districts	Country Districts
1851–60	24·7	19·9
1861–70	24·8	19·7
1871–80	23·1	19·0
1881–90	20·3	17·5

Referring for definition of town and country districts to the Registrar-General's annual reports, the above table shows the differences between urban and rural death-rates in England. It will be seen that the difference has been loss of recent years than it was twenty or thirty years ago. The town death-rate has decreased more rapidly than the rural, giving *primâ facie* ground for a belief that the towns have derived more advantage from sanitary measures than havo the country districts, where sanitation has been far less progressive.

[1] There is no official definition of what constitutes a town as opposed to a village, but the reader may have in mind a population of 2,000 or more, not widely scattered, as being here regarded as a town rather than a village. Let it be observed that the term 'urban sanitary district,' while it applies to the majority of English towns, can also apply to petty hamlets of two, four, or six hundred inhabitants. Some specialities of village and rural sanitation will be considered in the sequel.

The causes of the difference are various. In some degree, no doubt, the more rapid improvement observed in urban death-rates is to be attributed to the increasing migration from country into town of adolescents and young adults, whose contribution to the death-roll of any community is small compared with that of people at lower and higher ages. But, this consideration apart, we may be confident that the more rapid improvement in urban death-rates does in truth represent larger sanitary progress in town than in country. We have only to observe the larger scope for such progress afforded by urban populations.

In towns there is greater crowding of houses, with a higher degree of impurity in the air of the houses, more of complete destitution, a greater prevalence of infectious diseases, and greater exposure in unhealthy trades. The urban inhabitants are also on the whole more intemperate, feeble at birth, and have less active exercise in the open air than the rural population. In towns, compared with the country, it is especially the mortality of children under five years old which swells the death-rate, since it is the ages of infancy which suffer most from bad and improper food and from the impure air of the houses of the poor. In all cities there are districts, inhabited by wealthy people, where the mortality will bear comparison with healthy country places, even if age be compared with age in the population which yields the death-rate. It ought to be possible, therefore, to raise the health of the inhabitants generally towards the standard of these favoured parts; and the object of the local government should be, by thought and contrivance, to overcome, as far as may be, the difficulties that poverty puts in the way of health.

Hygienic Conditions of Cities, Towns, and Villages.—These are conditions referable to :

1. The site and soil.
2. The arrangement and building of houses.
3. The water-supply.
4. The removal of refuse-water and of dry refuse.
5. The removal of excreta.
6. The conservancy of the surface.
7. The supply of food, including the regulation of slaughter-houses, dairies, and bake-houses.
8. The regulation of trades.
9. The arrest of infectious diseases.
10. The disposal of the dead.
11. The supervision of nuisances.

1. *The Site and Soil.*—The sites of old cities were fixed by reason of war or commerce, or of vicinity to water-supply; when modern cities arise, it is often in consequence of the development of new industries, such as depend on coal and iron, or such as cotton or woollen works, where the site is determined by convenience of manufactures. In England new towns and villages spring up without regulation, and when they attain a certain size, and some sort of municipal government is formed, it is often too late to consider the wholesomeness of the ground or to attend to the arrangement and construction of houses. It were to be desired that the Legislature should secure for towns, during their period of growth and extension, adequate attention to such matters. For too often in the case of old towns Local Improvement or Health Acts are found to be needed, in order to remedy slowly and laboriously the errors of bygone times.

In respect of the *site* it is necessary to dry the ground if it is at all damp, and to keep it from being contaminated by injurious or offensive effluvia. It is one of the advantages of sewering towns that the ground is thereby drained; and brick sewers were formerly laid so as to admit subsoil water and drain the ground as well as to serve as channels for house-waters. For the former object of drying the soil, every town ought to have a system of pervious sewers; and for the second object, it is best to have a system of impervious sewers combined with the deep drainage of the soil. There should be no cesspits or middens, or manure heaps, in uncemented holes; every refuse of this kind ought to be removed and never allowed to soak into the ground. The ground ought in fact to be secured against every source of contamination. Paving of all streets and courts, so as to prevent surface impurities from soaking in, and great care in the construction of the public sewers, will keep the soil of a city free from those impurities which, under the influence of heat, water, and air, generate injurious effluvia that may be sucked into houses. It is necessary also to have rules about 'made ground.' Inequalities in the surface of the ground are often levelled by filling in with refuse of all kinds; house and chemical refuse, and dredgings from rivers, with other rubbish, are sometimes used. Decomposition goes on in such soils, and eventually, if not too foul, they purify themselves, but for this time is required. In the 'cinder refuse' of Liverpool, which is tolerably free from impurities, at least three years are required for the disappearance of the more easily decomposed animal and vegetable matters. In other made soils it may be longer; and when soil is very impure, as in the case of old graveyards, it is uncertain how long it is before it would be safe to build upon it. Every made soil should be well drained, so that air and water may freely pass through it, and the best should have been laid down for three or four years before being built upon.

The leakage of coal-gas from pipes is a point to be guarded against, and the case of

preventing this would be much increased by the use of subways.

With respect to the means of covering the sides of city streets for foot passengers, good stone paving or the like is essential; for it greatly increases the ease of cleaning the surface. Full powers are given to Sanitary Authorities for this purpose.

The question of the best kind of road for horse and carriage traffic is not quite so easily settled; there are four principal plans: macadamising, granite blocks, wood, and asphalte. As a mere matter of health the two last are preferable; there is less *débris*, greater ease of cleaning, and less noise. Both macadamised and granite-block roads soon get worn into fine mud, which is made up of finely comminuted stone mixed with droppings from horses, and the like. In wet weather this is washed into the sewers, which it aids in obstructing, and it forms a useless part of the sewage. In dry weather it becomes pulverised, floats in the air and is one of the ingredients of city air, from which it is deposited as dust. Wood and asphalte break up much more slowly and are more easily cleaned both by rain and by washing.

2. *The Arrangement and Building of Houses.*—The arrangement of houses and streets in towns is influenced by many circumstances. A good return for money, facility of locomotion, and beauty, are the chief considerations in new towns. In old cities questions of defence and of materials have especially regulated the size and direction of their streets, and the height and compression of their houses. Many considerations will always influence the formation of streets, but a free passage of air to all parts of a town is a cardinal point, which should receive the utmost attention. The more numerous and the wider the streets are, the less impeded will be the air-flow; in no case should a street be less in width than one and a-half times the height of a house.[1]

There should be open spaces, arranged to allow ready movement of air through them at the back of the houses, and all 'back-to-back' building should be illegal. The erection of narrow lanes and alleys should be prohibited in all new towns, and the back courts so common in our older towns ought to be gradually removed. Additional open spaces should be provided at intervals. Wide straight streets are useful for ventilation, and are best for the laying of pipes and tramways. Straight lines are by some not considered beautiful, but for the most part they are certainly most convenient.

Powers are given to Urban Authorities to make by-laws regulating the width of new streets, providing for sewerage, foundation of houses, spaces for air about houses, the drainage of buildings, and other points. As regards existing towns, these Authorities are enabled to purchase dwellings in order to improve streets, to set back houses when rebuilt, and in cases where only the front of a house in a street is taken down they may prescribe the line of the new building. Larger powers of demolition and reconstruction, moreover, are given by the Artisans' Dwellings Act and various local statutes. It has been said that due provision should be made beforehand for the proper construction of the many new towns which must needs spring up in the course of another century. The case seems clear for the community at large to regulate. Matters so important as these for the general health of the population are proper for Imperial legislation to deal with to a greater degree than has been yet recognised in any Act.[1] In their principles at least, such matters should not be relegated to Local Authorities, for them to accept and to use according to the local caprice of the moment.

An important point to determine is the height of the houses. In England a large proportion of our towns consists of low brick houses. If these are not too crowded they give a good distribution of the inhabitants, and oppose little obstacle to the movement of air. When the houses are very lofty the air-currents must be much more impeded, and therefore the streets ought to be much wider, and open spaces behind and about them ought to be more carefully secured. It is not possible to state with any precision the number of persons who may be located on an acre—this will depend in the main on the construction of the individual houses; but it may be laid down as a general rule that, however small be the size of the houses, the amount of ground not occupied by them in any given acre should be as great as the amount actually taken up by houses, and such a rule should *à fortiori* be maintained in the case of more populous houses. Where the houses of a town are intended, each of them, for the lodgment of several families, and consist (with the name of 'flats' or 'mansions') of a number of separate dwellings piled up on the top of each other, it is of even greater importance that the relation between inhabited and uninhabited area should be properly regulated.

[1] In some local Acts the width of a street is fixed at the height of a house, but this is too small.

[1] As an instance of the necessity of this State interference, the case of Liverpool may be cited. More than seventy years ago the Corporation was warned by the medical practitioners of Liverpool that the houses then being erected, and their arrangement, must prove unhealthy dwellings. No regard was paid to this, and now Liverpool will have to undo, at enormous cost, what might at the time have been put a stop to with ease. Numerous papers by Dr. Russell, Medical Officer of Health, of Glasgow, exemplify the same thing in a most striking manner, by the case of Glasgow.

Such flats or mansions ought, for the sake of air and light, to be provided with exceptional arrangements for space about them, with, concurrently, abundant ventilation of streets and provision of open spaces. They may serve to illustrate the foregoing contention as to the need for central control over the arrangements of streets and houses; for Local Authorities can hardly be expected to know the misfortunes that have befallen Paris and Edinburgh through want of due regulation of houses of this class. The construction of the separate houses cannot be altogether a matter of control absolute by a municipality; and certain rules as to ground-plan, foundations, and arrangement of closets, and the thickness of party walls are habitually enjoined by the State upon Local Authorities desirous of regulating their new buildings; while sufficient liberty is afforded to the requirements and tastes of individual owners and architects.

So in all houses, whether urban or rural, there should be means of ventilation for every room; no inhabited room should have a borrowed light, but should have a window opening directly on the external air; every window should open, and especially at the top; every room should be of good height, not less than nine feet in the smallest, and ten and eleven feet in larger rooms; the closets ought to be arranged in such a manner that, in addition to ventilation of the closet itself, there should be thorough cross ventilation into the open air between the closet and the rest of the house, and this is best accomplished by having projecting portions of the building to contain the closets; every house should be provided with closets in due proportion to its population; there should be proper water-supply, with easily inspected storage, if house-storage is permitted, and easy methods of carrying off the dirty house-water; there should be proper arrangements for the collection and temporary storage of dry house refuse; and house drains and pipes should be constructed and ventilated on the principles that will presently be set forth.

All these matters are easy to regulate without interfering too much with the plans of the architect.

3. *The Water-supply.*—In a town with sewers and water-closets it is generally considered that the supply of water per head daily should not be less than 25 gallons; and if there are trades using large quantities of water, from five to ten gallons additional (reckoned per head of population) are wanted for the town. If there are no water-closets, from 14 to 20 gallons per head daily appears to be the amount usually considered sufficient in large English towns.

The sources of supply are natural lakes, artificial lakes and gathering grounds, rivers, springs, and wells. In towns of any size superficial and shallow wells are always suspicious sources. Local Authorities have powers to undertake the public supply of water, and to protect water-supplies; also to close wells, tanks, cisterns, or pumps if the water be polluted.

The following are the matters of chief importance in towns: (*a*) The supply should be taken from sources capable of affording a quantity adequate to the present and proximate wants of the town, with such approach to constancy as may be attainable. In quality, the great points are to ensure that the water is clear or is easily or completely freed from sediment by sand-filtration, and is well aërated, pleasant to taste, and without smell; that it contains no injurious animal constituents, and cannot become contaminated with excreta of men or animals, or with foul water from houses; that it contains no injurious amount of vegetable matter (not more than 2 or 3 grains per gallon), and that its mineral constituents are of moderate amount, not exceeding 60 grains per gallon as a maximum, and consisting of such mineral matters as are not likely to be injurious. With respect to lime especially, much discussion has taken place as to whether soft or hard (from calcium carbonate) water is best for a town; the soft water is preferred for many trades and is probably best for health, though it has been found impossible to prove this by statistics; it is certain that the inhabitants of numerous towns using a good chalk water have excellent health, and it would seem in fact that the question between water hard from calcium carbonate and soft water is not an important one. When water is hard from calcium chloride and sulphate it is thought to be objectionable to health. The great point in choosing water is, in practice, its freedom from any chance of contamination with excreta, or with refuse matter from habitations.

The duties of a medical officer of health should include the supervision of the sources of supply, so as to detect and prevent any possible contamination.

The water when supplied, except in the case of deep well waters, most commonly needs to be stored and filtered. The reservoirs of our towns contain from one to three months' supply, or less if the supply is very uniform in quantity. The reservoirs require to be placed so as to be clear of trees, and protected from danger of anything being thrown into them. Filters are usually made of sand about 3 feet in depth resting upon gravel, and the water is passed through at the rate of from ½ to 1 gallon to every square inch of surface in 24 hours. The upper sand of the filters requires frequent cleaning, and should be regularly inspected. This plan acts well, but constant supervision is necessary.

After filtration the water is distributed

by means of pipes, usually by iron pipes, tarred or concreted inside, for the larger conduits, and then by lead pipes, or, what is better, tinned-lead pipes, for the smaller. Both iron and lead, and especially the latter, are dissolved by some waters, and the question whether lead is so dissolved has often to be answered; in examining into this matter the water should be taken after it has been in contact with the pipes for some hours.

Carried down the public pipes, the water is either delivered at intervals to house cisterns, or, what is far better, is supplied on the constant plan without house-storage. If it be not possible to dispense with house-cisterns, they should be well made of slate, stoneware, or galvanised iron, should be able to be easily inspected and cleaned, and their overflow pipes should always end in the open air, never go into any sewer. The greatest care should be taken that the cistern water shall run no risk of contamination by absorption of foul air or by soakage into the cistern, which should be well covered to prevent dust getting in.

If the 'constant system' is in force, it should be truly constant, for if the water is cut off at intervals and the house-pipes are then emptied, or if leakages take place in the street mains, air must be drawn into them, and this air may be foul; it has even happened that dirty liquids have been sucked into water-pipes, as where a closet service-pipe direct from the house-main has been connected with a choked closet-pan, and in this way excreta have not only passed into these house-pipes, but have even got into the mains. In a similar manner, when sewers are laid in the same trenches as water-mains, liquids escaping from leaky sewers may find their way through bad joints or fissures in water-pipes. This is most liable to occur during intermissions in the water-service; but the same insuction into water-pipes may occur while the pipes are full, if the water be running through them with great velocity. This fact is not sufficiently recognised, even by water-engineers; yet it has been concerned in the distribution of enteric fever broadcast in a community.

Under a constant system and under an intermitting system alike, small service-cisterns are needed for water-closets and for kitchen-boilers, and precautions have to be taken with these cisterns equally with larger storage-cisterns. In fact, too great care cannot be taken in thoroughly guarding water-pipes and cisterns in every way.

The sources of contamination of drinking-water are very numerous, and may affect the water at its source, in its flow, in the reservoir, or during distribution. If stored in houses it is especially exposed to risk; and this is the grand argument for constant service, that the water may be delivered immediately after filtration. The plan of cistern-storage, indeed, lessens those risks that are incidental to intermissions; but this plan demands that cisterns be properly made and placed, and be regularly cleaned. For low-rented houses these conditions are very difficult of attainment, and therefore the constant service is peculiarly adapted to the houses of the poor.

In all towns the service should be at high pressure, so that water may be carried to every floor and thus labour be spared, and the freshness of the water be secured. In places where the water is not carried into the houses, but is fetched from pumps or from 'hydrants' in the street, it has to be stored in the houses in buckets, and runs many chances of impurity.

A town requires water for public purposes, such as for public baths, washhouses, flooding and washing streets, flushing sewers, and putting out fires. Statutory powers are given for carrying out these objects.

4. *The Disposal of Dirty House-water and Dry Refuse.*—After being distributed and used in houses or trades, the water with the impurities it has gathered must be carried out of the town. The inhabitants should have no difficulty in getting rid of their dirty water, or else dirty water will come to be used improperly several times over. Houses ought to have convenient sinks discharging by trapped pipes opening outside the house, not into a drain, but over a drain-grating. From hence it must go along pipes or sewers, and be disposed of at the outfall in some way. House-water, besides other impurities, invariably contains some portion of urine. It is not fit to be at once discharged into streams, but as its fertilising powers are considerable it is well adapted for irrigation on land. The plan involving the least expense appears to be to filter it by intermittent filtration on a small area of properly prepared and drained ground, and then to carry it into the nearest stream.

The dry refuse of houses consists of cinders and ashes, remains of food, dust from sweepings, and various other used-up articles of house life. In some towns there is little difficulty in disposing of this refuse. After being carted away it is sorted, and every article finds a sale. In other towns, however, the disposal of the house-refuse is a matter of difficulty and expense. A system of destroying the refuse by fire in destructor furnaces has of late years come largely into use in various towns. The refuse contains a sufficiency of combustible material in the shape of cinders to ensure its complete destruction in a properly designed furnace, and the waste heat may be utilised for various municipal purposes, *e.g.* for converting the contents of pail closets into a dry manure, or for generating steam in boilers for driving electric-lighting machinery. The clinkers, when withdrawn from the furnace, can be

ground down in a mortar-mill and converted into mortar, bricks, or concrete. Sanitarily considered, the destruction by heat of dust-bin refuse is far preferable to the old-fashioned sorting method.—In some places the dry refuse is placed every day by the inhabitants in front of the houses and is removed by scavengers. In other places there must be storage of refuse on the premises for a varying number of days; if this is requisite, every house should have a properly prepared dust-bin, well-paved to prevent soakage, well-covered so as to be kept dry, and so placed as to be away from the house, though convenient for the house as well as for the town-scavengers. In the building of any house the arrangements for the position of the dust-bin are almost as important as those for the closets. Of late, galvanised iron pails with tight-fitting lids have come largely into use to replace brick dust-bins for the storage of dry house-refuse, and being non-absorbent they are far more cleanly and suitable receptacles than brick structures ever could be. The removal ought to be frequent and regular, but the frequency has to be fixed by special circumstances. As far as possible organic refuse (food scraps, &c.) should be burnt in the kitchen fire, and not stored on the premises to await removal by the scavengers.

5. *The Removal of Excreta.*—The excreta of the skin and lungs are got rid of by ventilation and washing, so that this heading refers only to the solid and liquid excrements. These average respectively (for both sexes and all ages) about 2½ ounces avoirdupois of solid excrement and 40 fluid ounces of urine *per diem.*

The excreta ought not to soak into the earth, or to remain near dwellings. The common privy and the 'midden' of northern towns can only with difficulty be brought to fulfil these conditions. In towns above 10,000 inhabitants it now seems clear that there is no possibility of using the earth-closet system, on account of the expense of preparation and transport of dry earth. Therefore, for towns, two or perhaps three plans only remain: (1) The dry plan with frequent removal, with perhaps such deodorisation as the ashes of the house may give; the so-called 'pail system' is one form of this dry plan. (2) The water system, the excreta being carried off from the house along drains and sewers, by the aid of water. (3) The air or pneumatic systems of Captain Liernur and M. Berlier, in which the excreta, unmixed with water, are sucked through pipes into a central reservoir by an air-pump, worked by a steam-engine. These last plans of removal will not be further considered here: they are as yet unfamiliar to us, and are perhaps not altogether well suited to English habits; they are now being fully tried on the Continent.

It would not be possible to discuss here the relative value and the technical details of the pail and the water systems. Both are largely used in England. The pail system, as the most adaptable (among dry systems) to the conditions of a town, has been used in towns where proper sewers cannot be made or water is deficient, or where land cannot be obtained for irrigation or filtration, owing to the expenses involved. It has the disadvantage of keeping the excreta for some days near the house, besides being sometimes attended with nuisances in the working. But, on the whole, it is capable of keeping a town clean when it is properly carried out, and it is an immense advance over the old midden and cesspool systems, which retained the excreta in the filthiest receptacles for long periods in the very midst of the people. It is of the essence of the pail system that the removal of the excreta should be frequent, that is, if practicable, every day. After removal, the excreta are applied at once to the land, or are made into poudrette. In some towns the house-ashes are thrown on a wire screen, so as to allow the fine ash to fall on the excreta—this is sometimes called the 'ash plan'; in other cases deodorants are used. The 'Goux system' is to place some absorbent material round the interior of the pail to absorb the urine.

The water system is more elaborate, and probably more expensive, but if properly carried out is more effectual. If a town can make good sewers, and can find water for flushing and land through which the sewer-water can be passed (by filtration or irrigation, or both), the water system is the best for health.

There cannot be many towns deficient in the quantity of water needed for the proper use of a water system. By some simple contrivances waste water—the water that has been put to other domestic purposes—can be made use of for washing out the closets. Slop-closets and trough-closets, in which these contrivances are used, are found to work efficiently, and to economise water in places where there is but scant supply.

The drainage of every house that discharges its excrements by the water system should possess the following arrangements for disconnecting the drain-air from the air of the common sewer, and for dispersing the foul air of its own particular drain: (*a*) near the junction with the sewer the house-drain should be provided with a 'siphon-trap,' through which all the liquids of the house must pass, and which, therefore, must always be charged with water while the house is inhabited; (*b*) an opening from the house-drain to the outside air, made on the house side of the siphon-trap, to provide for the escape of any sewer-air that may force the trap: the habitual function of this opening, however, is to serve as an inlet to the house-drainage ventilating system; the outlet of

this system being (*c*) a pipe in continuation of the farther end of the drain carried up 'full-bore' to the roof, its end at this spot being left open.

It is essential that sewers should be well constructed; they should allow no deposit; and they should be thoroughly ventilated. Deposits are prevented by having egg-shaped sewers with a proper fall, easy means of access for inspection and cleaning, and a regular flow of water, with periodical flushing. The ventilation of sewers, which is now enforced by law, is best effected by having numerous openings—as many, in fact, as can be made—so as to allow constant and free interchange between the sewer-air and the atmosphere. These openings may be by street-gratings or by special shafts, according to circumstances. Ventilation through furnace chimneys is inadvisable, and is of no avail for distant portions of the sewers. For the dead ends of sewers and in narrow streets and courts, shafts of not less than 6 inches diameter, carried up from the crown of the sewer to above the roofs of the houses, should be provided. But in whatever way the ventilation is carried out, the rule must be to have the freest communication between the sewer-air and the general atmosphere. This free ventilation occasions no offence if the sewers are properly made and kept; while, if the air of sewers at the ventilators is found offensive, the ventilation will at least have provided against the more dangerous discharge of the foul air into houses.

Sewers have been objected to on account of the occasional spread of typhoid fever and diarrhœal affections, and perhaps of cholera and diphtheria, by their agency; but, if properly arranged, and with disconnexion between the sewer and houses, there would be no danger; and it is difficult to see how sewers can be displaced, or any other plan be substituted for them, in a town. The house-water must be carried off, and it is impure even if no excreta are allowed to flow in. Even if the pail or other system for excrement disposal be adopted, there must still be town sewers for dirty house-water, and all the precautions above alluded to must be enforced. Sewers, then, whether or not they receive the excreta of a town, are a necessity, and with proper construction and management they certainly ought to be solely beneficial to the public health. It is certain that when a town is well sewered the prevalence of enteric fever is lessened even to the point of extinction, and diarrhœal affections have appeared to be more uncommon. Drying of the soil by sewers also lessens phthisis. It is to a certain extent a question of engineering detail whether the sewers carrying the house-water should also carry off the rain-water; but there would seem to be very considerable sanitary advantages in the 'separate' system by which different channels are provided for house-sewage and rain-water; the chief, perhaps, being that under this system impermeable pipe sewers of small diameter may be used to convey the sewage, preventing by this means the soakage of foul liquids into the soil. The sewer-water also on this separate system is less in amount, more regular in flow from day to day, and richer in fertilising properties. Wherever towns situated on moist grounds have adopted a system of impermeable pipe sewers for conveying away house waste-waters and excreta, means should be taken to dry the subsoil by laying porous drains at a sufficient depth. The rain and surface waters may be carried off by surface channels and gutters, where the levels permit, or in other cases by the subsoil drains.

With regard to the disposal of the sewer-water, three plans can be followed in the case of towns which cannot discharge at once into the sea or into a large river. First, precipitation at the outfall with a chemical agent such as lime, sulphate of alumina, protosulphate of iron, clay, &c., used either singly or in combination. A great number of chemical agents have been proposed, and several clarify the water fairly, but none yield a deposit which pays the expenses as manure, for the suspended matters of sewage which are deposited in the settling tanks only form about one-eighth of the valuable manurial matters of sewage, the remainder escaping in the effluent water. Precipitation must, however, be had recourse to when land cannot be obtained. Second, broad irrigation—one acre on an average being sufficient for the excreta of about one hundred persons. Third, intermittent filtration, where one acre is sufficient for from 2,000 to 3,000 persons, when the land is of a light and porous nature, or is otherwise suitably under-drained, more especially also when the sewage is clarified by a preliminary precipitation; the land should be subdivided into plots, each plot receiving water six hours out of the twenty-four. There can be little or no profit from intermittent filtration, as the extent of land to which sewage can be applied is usually too small to produce crops in any quantity. In broad irrigation, enormous crops of grass and roots can be grown on the sewage land, but the realisation of a profit will largely depend upon the demands of the local markets, and such crops may at times be produced in excess of the demand. Some method of land treatment, however, appears to be the only one which is capable of satisfactorily purifying the sewage, producing an effluent of sufficient purity to be admissible into any stream, and at the same time utilising to some extent the valuable manurial ingredients of the sewage, so that these are not utterly wasted as they are in all precipitation methods.

It appears certain that neither irrigation sewage-farms nor filter-beds, when properly

managed, and at reasonable distance from houses, are anywise injurious to the public health.

6. *The Conservancy of the Surface Area.* The cleansing of the surface area of towns has long been a function of the public Authority. The sanitary importance of thorough surface-cleansing is obvious; the mud and dirt of towns and refuse of all kinds, wetted by rain and exposed to heat, soon decompose and give out injurious effluvia, especially in narrow courts and lanes where the movement of air is impeded. The excellent effect on health of paving a town has been often observed. Public streets of all kinds can be easily kept clean, but want of paving and consequent foulness on private premises require to be sought out. Especially this is of importance where (as in the case of pigsties and stables) neglect of surface-cleansing may give rise to nuisances injurious to health.

7. *The Supply of Food, including the Regulation of Slaughter-, Cow-, and Bake-houses.*—A very important duty of a municipality is to supervise the food of the people. While the price and quality must be left to the ordinary operations of commerce, the responsibility of preventing falsifications, and of ensuring that the article shall not be injurious to health, is devolved upon County Councils and on Sanitary Authorities. It is to these latter bodies that the regulation of slaughter-houses and knackers' yards is entrusted. Private *slaughter-houses* are licensed, and can be visited and subjected to bye-laws. They are often constructed out of buildings intended for other purposes, are not fitted with proper appliances, and are generally placed in the densest part of the town. The evils attending them are gradually being removed by the erection of public slaughter-houses, where abundant air, water, good sewers, and means of cleansing are provided. The custom of slaughtering in the country and then sending the meat to cities is increasing, and this again renders private slaughter-houses less necessary.

The transport of cattle and sheep to towns is a matter of very great importance as respects both the goodness of the meat and the comfort of the animals. Space in the trucks, supply of water and food, length of journeys, and other matters, require regulation.

Cow-houses are now inspected by Sanitary Authorities, in pursuance of the powers of the Dairies, Cow-sheds, and Milk-shops Order of 1885. This order contains provisions for the registration of cow-keepers, dairymen, and purveyors of milk; for regulating the lighting, ventilation, cleansing, drainage, and water-supply of dairies, cow-sheds, and milk-shops; and prescribes the precautions that must be taken to guard milk against exposure to infection or contamination. These latter precautions are especially necessary in the light of the knowledge we now possess of the spread of epidemics of enteric fever, scarlet fever, and diphtheria among human communities by the agency of milk; and it is gradually becoming more and more certain that if these disease outbreaks are to be effectually limited, not only must the sanitary arrangements of dairies and cowsheds be under constant supervision, so that the milk may receive no impurities from water or air, but that the animals themselves must be periodically inspected; for there is now evidence to hand that diseased conditions of the cows themselves may be the means of imbuing the milk with infective properties. It will be sufficient to mention two diseases alone, namely, scarlet fever and tuberculosis, as having been connected on very strong evidence with the consumption of milk from cows suffering from, on the one hand, a peculiar disease now known as the 'Hendon' cow-disease, which is closely similar in character to human scarlet fever, and on the other hand from tuberculosis with deposit of tubercles in the teats and udders.

Bakehouses are required by law to be kept in a cleanly condition, to be properly ventilated and protected from effluvia, and not to be used as a sleeping-place.

The inspection of the chief *articles of food*, in respect of their wholesomeness, is entrusted to Sanitary Authorities, and has reference to meat, game, poultry, fish, fruit, vegetables, corn, bread, flour, and milk.

The following are the chief sanitary points in each case:—

Meat.—Much doubt exists as to the extent to which the condemnation of meat exposed to sale should be carried. There is no doubt that meat sufficiently decomposed to be discoloured and to have a putrid smell, and meat with abscesses and suppurations, should be condemned, but the difficulty arises with meat apparently sound or not very obviously otherwise, but which is derived from diseased animals.

Though opinions differ on this point, it may perhaps be said that meat derived from animals slaughtered in the early stages of inflammatory diseases and of epidemic pleuro-pneumonia may be used, but that beef from cattle dead of cattle-plague and anthrax (malignant pustule), mutton from sheep with small-pox and splenic apoplexy, and pork from pigs with carbuncular diseases, hog-cholera, hog-typhus, and scarlet fever, should not be used, although it is not easy to give conclusive evidence against all these diseases, as injuring the health of consumers of the meat. Cattle-plague meat, for example, has been largely used without injury. Opinions are much divided as to whether the flesh of braxy sheep, or of cattle dead of foot-and-mouth disease, should be used or

not, but at present the evidence is rather against the view that such flesh is injurious.

In the case of the parasitic diseases of animals the question is easier. It is of course highly dangerous to use pork with trichina. Cysticerci in pork, beef, and mutton should also be a valid ground for not permitting the sale, for it is not enough to expect the destruction of the parasite by the cooking that the meat will receive. If it be contended that the prohibition would affect supply, the answer is to be found in the consideration that breeders and salesmen would take greater care in preserving the cattle from parasitic infection; and that this can be done, by supplying pure water and clean food, is shown by the experience of Upper India.

Flukes in the liver do not constitute a valid ground of rejection of the meat, though the liver ought not to be eaten.

On the whole, it may be said that it is certainly wiser to condemn all meat which is derived from diseased animals, even when the animals are slaughtered, and most certainly when they have died of disease, for there are possible risks in the consumption of such food, and the State is warranted in interfering to prevent the individual being exposed to any such dangers. In the very important case of meat derived from tuberculous animals, medical opinion is now inclined to advocate the prohibition of sale of the carcasses for food, arguing that there is always a possibility of tubercles having been deposited in those parts which are used as human food. The question is at the present date under consideration by a Royal Commission.

Some very remarkable examples of an acute specific disease of peculiar characters have recently been observed among consumers of meats derived from the pig; where the sole evidence of disease in the meat has been the presence of a cultivable bacillus or of a poisonous ferment generated by it. Whether or not these morbid elements have been acquired during storage of the meat (more usually than from the animal furnishing the meat) is at present undecided. There would seem to be no doubt of the occurrence of cases where meat has received its poisonous quality during storage. *See* POISONOUS FOOD.

Sausages when musty and strong-smelling should be rejected, but, owing to the spices used, decomposition is not easily made out. The peculiar 'sausage-poison' has not been identified.

Wheat-flour and bread.—The chief points are to ascertain that there is no ergot, no fungi, nor acari; that alum has not been used; and that other grains or mineral matter are not mixed with it.

Of *Milk*, the chief falsifications consist in addition of water or removal of cream. Falsification in other ways is not common. Milk may also be improper for use owing to the presence of blood, lacteal casts, and pus; and unquestionably it will be dangerous if it have been derived from cows affected with the diseases before mentioned. Yet there are no ready means of discerning this dangerous quality, and therefore it is greatly to be desired that English people would adopt as their invariable rule the custom of many Continental countries to boil all milk before it is used as food. This, however, cannot be ensured by legislation.

Other foods are not often concerned in the production of disease, except in so far as they may have undergone decomposition. Accordingly they less often come under the cognisance of health officers than of the analysts appointed under the Sale of Food and Drugs Acts. It may be defined as the business of these analysts to determine whether or not an article really is what it professes to be; to detect the presence and amount of foreign substances, or of decomposition and putrefaction; and sometimes to show whether or not a given specimen reaches a certain appointed standard of value. The law permits mixtures to be sold in some cases, if the admixture is stated on a label.

8. *The Regulation of Trades.*—Trades are affected by the law under two aspects: 1st, irrespective of the nature of the particular trade, the *place where it is carried on* is regulated under the Mines, Factories, and Workshops Acts, and by the Public Health Act of 1875. Urban Authorities can make bye-laws regulating offensive trades, such as blood and bone boiling, fellmongery, soap, tallow, and tripe boiling, &c. The object of these Acts, among other things (such as restriction of labour at certain ages), is to provide that the common conditions of health are not violated. This is a very necessary point, for many workshops are deficient in light and air, are badly ventilated, or are rendered unhealthy by gas burnt for light. Many small workshops are owned by men of small capital, who would sacrifice the health of workmen by compelling them to work under very unfavourable conditions. Happily the faults are usually easily remedied by a little common sense and simple appliances, and in this respect the Workshops and Factories Acts have done great good. One special fault in many workshops is, however, still common, namely, the burning of gas in large quantities in dark shops, without proper means of carrying off the products; the very great influence of this condition on the lungs was long ago pointed out by the late Dr. Guy.

2nd. The other point in the regulation of trades is to prevent any of the *processes being nuisances* or injurious to the health either of the workpeople or the inhabitants of the surrounding districts. This is an

extremely wide subject. Trades may annoy and inconvenience the public, as by offensive effluvia, black smoke, or acid vapour which destroys vegetation, yet may not be distinctly injurious to health. On the other hand, without being notable nuisances in the above sense, they may be hurtful to health, especially those (and they are very numerous) which give rise to dust in the air of any kind. Cotton and woollen *débris*, filings and grindings, particles of size, clay, dry paints, and many other substances, come under this head. There is no doubt that the inhalation of all solid particles, no matter whence derived, is highly injurious to health. Much debate has taken place as to whether certain gases, such as chlorine, iodine, sulphuretted hydrogen, sulphurous acid, or the fœtid vapours given off from catgut, gelatine, manure, and other trades, are or are not injurious to the health of the workmen, or persons living near the factories. In many cases the discussion is not closed, and fuller inquiries are necessary; but at present it seems as if these gases and fœtid effluvia, in such proportions as they are met with about factories, are not proved to be unhealthy (though their innocuousness cannot be asserted), however disagreeable they may be. On the other hand, some really dangerous gases, such as carbonic oxide, are not offensive to the smell. Phosphorus fumes escaping into the air have affected the jawbones of persons exposed to them; this happens now much less than formerly, owing in large measure to the increased use of red or 'amorphous' phosphorus in the manufacture of lucifer-matches.

The spread of *infection by trade operations*, as of anthrax among wool-sorters, and of small-pox among paper-makers, has recently come to demand recognition.

There is one article, the sale of which gives rise directly and indirectly to a large amount of sickness, and the trade in which certainly requires better regulation, if the public health is to be regarded. This is *alcohol* in its various forms. Owing to peculiar social customs, and to the insufficient recognition of the immense amount of harm produced by excess of alcohol, the laws of this country have not only legalised the sale of a dangerous article of diet, but have actually encouraged the sale, until an evil so gigantic has been produced that no one has yet suggested a reasonable remedy. Yet the sale of alcohol is so distinctly a source of disease and of injury to the State, that it must be considered by those who have charge of the Public Health, and in some way must eventually be restricted. One source of the error seems to be that alcohol is regarded by the State, not only as a source of revenue, but as the one indispensable article of 'refreshment.' There is, of course, no question that the public must be supplied with houses where they can obtain proper refreshments, such as meat, bread, vegetables, milk, coffee, tea, or other articles of the kind; and 'public-houses' were intended to supply articles of this description as well as the alcoholic liquids which enter into the ordinary diet of most people. Yet, unfortunately, a system has grown up by which our public-houses have become places where little else than alcoholic liquors are sold, and this system is defended on the ground that such liquids constitute 'refreshments.' The amount of temptation which has been put in the way of our working classes by the heedless multiplication of these drinking-shops during the last forty years accounts for much of the drunkenness which so deeply affects our national life, and injures the health of the people. A remedy ought and must be found for this state of things, or else legislation will continue to present the absurd spectacle of raising up one huge mischief to the public health, while it is all anxiety to rid the community of every other.

9. *The Arrest of the Contagious and Infectious Diseases.* — Small-pox, scarlet fever, measles, whooping-cough, diphtheria, enteric fever, typhus, and relapsing fever will here be considered. Among other contagious diseases syphilis and gonorrhœa must be referred to.

Of late years, since the recognition of the fact that each of these diseases possesses a *materies morbi* of its own, and spreads under conditions which have become more and more definable, the prevention of the infectious diseases has become much easier, even though the exact conditions and the natural history of the morbific material be not yet completely known. The general principles on which the prevention is based are—(1) The recognition of the places of origin and conditions of formation of the morbid agent, with recognition, also, of the processes to which it gives rise, alike in structures of the human body and in substances outside and independent of the body, with further question as to the nature of these substances, structures, or processes; the more fully these points are known, the more it is to be expected that the formation of the agent can be prevented or the agent be made harmless. (2) The recognition of the means of spread of the agent, after its first formation, that is, whether it spreads directly through the air, and, if so, through what distances and under what conditions; or whether it is carried in drinking-water or in food, or is transferred directly from one person to another: in proportion as this recognition has been gained, the carriage of the morbid agent may be stopped. (3) The early removal of the person affected from among the community, so that the risk of spreading in any way may be lessened. The system of compulsory notification of infectious disease has rendered it

possible for the local authorities of towns to keep infected children out of schools, and by other like means to limit the opportunities of infection; and also to secure the isolation of infectious cases as they arise or are imported into the town, and thus at once to stamp out an impending epidemic. By the exercise of due vigilance and proper sanitary precautions it may now be hoped that epidemics of the more serious infectious fevers will be very largely held in abeyance.

In the case of each of these diseases the preventive measures are different, and it is impossible here to go into so large a subject as the specialities of each. The measures include a continual supervision over the conditions of origin, introduction, and spread, as far as they are known.

Two points must, however, be noted more particularly. The first is the isolation of persons ill with any disease which directly or indirectly can spread from one person to another. In the crowded houses of towns some diseases, such as typhus, scarlet fever, measles, and relapsing fever, spread with great rapidity, and the only means that we at present possess for checking them are to remove the sick at the earliest moment from such houses, and to prevent persons ill with infectious diseases from exposing themselves in public places and conveyances. For this purpose Sanitary Authorities have powers to remove persons ill with infectious diseases to a proper hospital in special conveyances; to prevent sick persons frequenting public places or conveyances; and to deal with infected rooms, houses, and clothing. Hospitals for infectious diseases can also be built, and are now being constructed in many towns. It would appear *primâ facie* to be desirable to make them simple, cheap buildings of wood or iron, able to be thoroughly cleaned, or after a term of years to be destroyed and replaced; but the objection to hospitals of this class is that authorities habitually postpone the provision of them, so that they are seldom in readiness for the reception of the earliest cases of an infective disease. Isolation hospitals should provide an air-space of 2,000 cubic feet, with a floor-space of 140 square feet, for each patient, and efficient separation between patients suffering from one and another infectious disorder. The freest ventilation, supply of water, and means of disinfection are essential.

The second point that needs special care from Sanitary Authorities is the provision of due means of disinfection for the community. They are empowered to erect a proper place for disinfecting clothing and bedding; and disinfecting chambers (heated by hot air, steam, or gas, and in which a heat of 240° F. can be reached) are now provided in most towns for the immediate disinfection by heat of all soiled clothes taken from patients with infective diseases. High-pressure steam, in an apparatus contrived for the intermission of its pressure, is found to give the best heat-penetration to large non-conducting articles such as bedding; and disinfecting chambers on this principle are to be commended for public use.

The disinfection of infective excreta and discharges from sick persons, together with any articles that may have been soiled by such matters, and disinfection of rooms that have contained infectious patients, have also to be secured. The poison of typhoid fever can be destroyed by strong chemicals added to the intestinal discharge; and the spread of typhus has been also lessened and perhaps arrested by aërial purifiers, especially nitrous acid fumes.

Small-pox is controlled by vaccination, and for this there are special laws and a special organisation. It has been expected that by following the lines indicated by the experience of vaccination, the community will hereafter gain some like means of control over other epidemic diseases; as well as over other diseases, also, of which the infective character has only lately been established.

The prevention of syphilis and gonorrhœa by periodical inspection of prostitutes, and removal of them to Lock Hospitals when diseased, was until recently carried out in this country in certain military and naval stations, where the effect has been to lessen primary syphilis by nearly one-half, and to abate its virulence. The operation of the Contagious Diseases Acts upon the women, in respect not only of curing them but of influencing them for good and of reclaiming them, was very remarkable. In Germany, France, and Belgium precautions against venereal diseases have been carried out among the entire population for many years, with the effect of greatly lessening the amount and virulence of syphilis. Although the Contagious Diseases Acts have not been actually repealed, they are not now enforced, either in the home military stations or in India. The result has been that venereal disease has increased enormously in the army. In 1887, out of 63,000 European troops in India, 23,000 were admitted to hospital for venereal disease (equal to a rate of 361 per 1,000 of strength); of the 23,000 admissions no less than 10,000 were for various forms of syphilis. When the Acts were in force in India the admission-rate was only about 180 per 1,000, or half of the present rate. A similar increase has been noted amongst the home troops at those stations where the Acts were formerly in operation. Put on the lowest ground, considerations of economy would appear to dictate a revival, for the army and navy, of these Acts—of course, with such modification of their provisions as experience may have indicated.

A variety of cogent objections against the application of these statutes to the civil population of the United Kingdom has been advanced, principally by Simon. Nevertheless, having regard to the extensive and most mischievous operation of syphilis upon the community, it is greatly to be hoped that the Legislature may before long give its attention to this subject, and endeavour to reduce by acceptable measures, primarily in the interests of children, the amount of syphilis which now afflicts the people.

10. *The Disposal of the Dead.*—Two points are involved in the disposal of the dead, both in towns and villages.

In this country, where so many families live in single rooms, and where the custom of keeping the dead five or even six days before burial is usual, it constantly happens that a corpse is kept for days in the room where all the family life is carried on. As decomposition, especially in some diseases, commences early, it cannot be doubted that an unfavourable effect on health must be often produced. To avoid this detention, mortuary chapels ought to be constructed in all towns and villages, and to these all corpses should be removed from the houses of the poor within thirty-six hours after death.

Power has long been given to Local Authorities to provide mortuaries, and to remove, when necessary, corpses from rooms where persons live and sleep. Very little has as yet been done in this way, and England is in this respect far behind some of the Continental States.

The other point is the disposal of the corpse. The law of England now allows no burial-grounds in large cities, nor burial under churches, and consequently cemeteries are provided at convenient distances from towns. These cemeteries ought to have a dry soil, so that the ground-water shall never rise high enough to wet the corpse or to float it up in the vault, as sometimes has happened; they should be as far from houses as practicable, and a limit of 200 feet is contemplated as a permissible minimum. There should be good drainage, and the water should not run into any well or watercourse from which drinking-water is taken; the site should be well ventilated and well planted, so that the roots of plants may absorb the decomposing matters. The kind of soil will, of course, depend on the locality; in many cases there is no choice; but if there be a choice, a marly soil, not too stiff, but allowing free permeation by air and free flow of water, should be chosen. Gravelly soils act pretty well, but are said to form a compact mass round the body, which prevents access of air and moisture; the lime and chalk soils act better, and especially if the soil is alkaline; very stiff clay preserves bodies longer than less compact soils.

Bodies decay in very various times, according to soil, access of air, amount of pressure, &c. In some cases a corpse may be destroyed in three years. When ground has to be used over again, a period of from five to thirty years is allowed in different countries before the second use. Bodies should be buried deeply (4 to 6 feet) in order to lessen the chance of contamination of the air, though it is supposed that when the graves are shallower, decomposition is more rapid; the graves should not be bricked, but the earth allowed to rest on the coffins.

It has been proposed to use not coffins, but sheets or wicker-baskets, so as to let the earth at once come in contact with the body; and, in fact, in many villages in England it was formerly the custom to carry the corpse in a coffin to the churchyard, but then to remove it from the coffin and place it in the ground in a sheet. If the coffin is not made too strongly, it is probable that it does not much delay decomposition; so that this point does not seem very material.

The decomposition of bodies occurs by putrefaction, with rapid disengagement of effluvia; or by a sort of insensible decomposition, the products undergoing further change by the action of the earth, as soon as they are formed. In other instances the decomposition is by 'saponification.' This last condition is said especially to occur if the earth is too closely pressed on the body.

As in some cases conveniently situated and proper land cannot be obtained, a discussion has lately arisen whether burning, or, in the case of seaboard towns, burying the body in the sea, might not supersede burial in the ground.

There being no law to prevent it, numerous cremations are now carried out every year in this country. If precautions are taken to prevent any possibility of the burning of the bodies of persons who have met their death from criminal means, there cannot be any medico-legal objection to cremation. On sanitary grounds cremation must be held superior to earth-burial with its actual abuses in the shape of overcrowded cemeteries, and appears to offer an alternative solution to a difficulty which presses more and more heavily as population increases in density, and suitable land in the vicinity of towns becomes less easy to obtain.

11. *The Supervision of Nuisances.*—The word 'nuisance' has been adopted into sanitary law, without any fixed idea of the relation of the word to health or disease. 'Nuisances' are defined as being a number of enumerated conditions, some of which have to be 'injurious to health,' while others need not be injurious to health (but have only to be obnoxious), in order to bring them within the provisions of sanitary law. The confusion thus arising has been such that the

primary object of sanitary legislation has sometimes been obscured. So much, indeed, has this been the case that, in comparatively recent times, it has been contended that a given condition which habitually does harm to health, but which had not yet, in the particular instance, succeeded in effecting actual disease, is not a 'nuisance injurious to health' within the meaning of a Public Health Act. The contention, however, has not been adopted by the Courts.

It is the duty of every Sanitary Authority to cause inspection to be made of their district to discover 'nuisances,' as enumerated in sanitary statutes; and a certain procedure for the abatement of 'nuisances,' and for the prevention of their recurrence, is appointed by sanitary law. For the performance of these functions the Authority is required to appoint one or more Inspectors of Nuisances, to whose office certain powers are attached.

The work of nuisance-inspection in its everyday concern with conditions injurious to health cannot be properly performed without the constant and intimate relation of the Medical Officer of Health with the Inspector; and those districts are unquestionably best served as to sanitary inspection where the Authority has devolved on the Medical Officer the duty of instructing the Inspector and of supervising his work.

Specialities of Rural Sanitation.—While the objects to be gained by sanitary action are of course the same in town and country, the methods of attaining them in rural places must needs depart in some measure from those which are available in towns; and accordingly sanitary law in its administrative aspects recognises rural as distinguished from so-called 'urban' districts. Rural Sanitary Authorities, constituted in 1872, can now exercise considerable powers; and where properly set in action by their Medical Health Officers and Inspectors of Nuisances, a great effect is being gradually produced upon the rural labouring class, whose condition had long been neglected. The Rural Sanitary Authority may provide water for public use, may make public cisterns or baths, may protect water-courses, may construct sewers and dispose of sewage matter; must take care that no closet or privy is a nuisance; may clean ditches and remove refuse; and may make regulations as to cellar-habitations and common lodging-houses. Much increased power of securing proper water-supply in the particular house within rural districts has been given, and there are few urban powers which cannot be acquired, if wanted, by any locality that can make a claim for consideration as a 'contributory place.' All powers possessed by urban Authorities as to trades, sale of unwholesome food, removal of nuisances, providing mortuaries and hospitals for infectious diseases, are now also possessed by the rural Authorities.

At present, however, comparatively little sanitary progress has been made in rural districts; and unquestionably there are some obstacles, inherent in the case, to any rapid progress. The difficulties arise from the houses in the rural districts being, in a great number of cases, old, dilapidated, unsuited for dwellings, and destitute of proper conveniences. When new houses are built, the Sanitary Authority can enforce certain provisions, though it has far less control over building operations than is possessed by urban Authorities. In the case of houses already built, however, its power is, from circumstances, even more limited. There is very little money available for improvements; the poor-rates are already often heavy, and guardians hesitate to increase them. The small number of houses in villages also, in comparison with the outlay needful to supply sewers and water, renders the cost per head much greater than in towns. In addition to bad construction and dampness of houses, the most frequent sanitary defects of rural places are as follows: The water is too often drawn from shallow wells or from small streams polluted by soaking, or even from stagnant pools or ditches, and its supply is limited. Often there are no means for carrying away the dirty house-water, and it is thrown on the ground and soaks into the soil close to and under the cottage; the excrements are generally thrown into an ash-pit near the house, or pass into a cesspit, from which they gradually soak, in such way as to pollute both ground and water. These difficulties, however, are being gradually overcome in districts which have secured the services of a first-class Officer of Health, who has sought, by means adapted to the special local conditions, to obtain the same sanitary advantages that are got in town districts by the use of more organised sanitary operations. Attempts are now being made to purify and then to guard the wells; to collect rain-water in proper tanks when other sources are not available; or to store the water collected (in the manner recommended by Mr. Bailey Denton) from the surface-soil of some area secure from drainage, manuring, or like impurities. For the disposal of the slop-water, open or partially closed surface drains leading to ditches, or underground drains that shall allow the water to flow into the soil, and other plans, have been proposed. It is, on any plan, important—but especially if shallow wells or the surface soil is to furnish the drinking-water—to carry off to a distance all the slop-water by drains of some kind. For the removal of excreta (as sewers are generally out of the question) a pail system, with or without the use of dried earth or charcoal, according to circumstances, has to be used.

If the cottages have gardens, then the simplest dry-earth plan, with proper storage and the subsequent digging into the gardens at intervals of not more than three or four weeks, seems to answer well; yet it is very difficult to get peasants to attend even to this simple matter. A plan of conjoint action in the procuring, drying, and distributing the earth, and in the removal of the mixed earth and excreta, answers well when care is taken. In other cases a pail system, with weekly removals, and without the use of earth or other appliance, has been employed, and may answer, as the manure has some value.

These seem at present the directions in which the opinions of Medical Officers of Health are tending where villages and labourers' cottages are concerned, and where larger works cannot be undertaken. The object, of course, is to obtain for the rural community by simple means, and at not too burdensome a rate, the sanitary requirements of pure soil, of pure air, and of pure drinking-water.

Houses.—The inside of a house is supposed to be beyond the control of the public health Authority, and is so to a large extent, but not altogether. The law takes cognisance of the existence of *nuisance* inside, as well as outside, a house; and has special provisions for securing wholesomeness of habitation in the following cases:—

1. *Common lodging-houses* have been regulated since the great Public Health Act of 1848, the authors of which were evidently profoundly impressed with the great evils of overcrowding. The definition of a common lodging-house that is now usually accepted is that given by the law officers of the Crown in 1853—namely, a house in which persons of the poorer class are received for short periods, and, though strangers to one another, are allowed to inhabit one common room. These houses are registered and inspected; the number of lodgers is fixed; and ventilation, cleanliness, and water-supply are now attended to. A certain cubic space per head in the sleeping-rooms of these houses is generally fixed by the Authority. In the Metropolis (where Acts administered by the police remain in force) 240 cubic feet, in Dublin and many other towns 300 cubic feet, are required for each adult inmate.

2. *Cellar-habitations.*—Since 1848 it has been unlawful to use cellar-habitations, unless they are in accord with certain conditions of space, height, window area, and drainage. By the Public Health Act of 1875 it is made unlawful to use any cellar as a dwelling (that is, a place where any person passes a night) which has been built or rebuilt after the passing of the Act, or which was not lawfully in use when the Act was passed. A cellar is defined by various statutes to be any room of a house, the surface of whose floor is more than three feet below the surface of the footway of the adjoining street; and it has to fulfil a number of conditions before it can be legally inhabited.

With the supervision that has been given to common lodging-houses during the past thirty years, they have become much healthier and more decent habitations. During the same period the number of cellar-dwellings in our towns has much decreased, and the condition of those still used has notably improved.

3. '*Houses let in lodgings*,' or occupied by members of more than one family. These are distinguished from *common* lodging-houses, and would more conveniently be termed *tenemented* houses. Sanitary Authorities have various important powers conferred on them in respect of this large class of houses where two or more families live in the same house. But, for these powers to arise, the consent of the Local Government Board is required.

4. *Overcrowding.*—This condition, so dangerous to the health of the inmates, is to be regarded—no matter in what house it is observed, or whether the inmates be of the same family or not—as a nuisance, and is to be dealt with as such. The question arises, what is overcrowding, and usually the common lodging-house rules are taken, namely, an air-space of 300 cubic feet per head. But there is no legal definition, except in Scotland, where the General Improvement and Police Act of 1862 enacts that children under eight years of age shall have 150 cubic feet, and persons over that age 300. Obviously, the standard of space per person adopted as the minimum in the *bedrooms* of common lodging-houses, where the occupation is by night only, is too small for those who have to occupy the same room both by day and night, as is usually the case, where the question of overcrowding arises in the dwellings of the poor. It would be very desirable to raise the minimum (at all events for persons over ten years) to 400 cubic feet, and this is really little enough.

Although public authority does not extend to all the conditions which are next to be passed in review, it will be convenient to consider together the various causes of unhealthiness of houses.

Causes of Unhealthiness of Houses.

1. *Dampness.* — Dampness arises from a damp soil, water rising into walls, rain beating through walls or coming from a leaking roof, or blocked water-pipes. Paving, concreting, damp-proof courses, hollow walls, &c., are the remedies. Damp houses are unhealthy, it would appear, by reason of the lowering of warmth helping to catarrhal

and rheumatic affections, and probably by reason of increased bacterial life due to the constant presence of moisture.

2. *Excessive coldness of air from draughts or from insufficient warming.*—Although an airy house is the healthiest, there may be excessive or irregular movement of air, so that strong currents are caused, with consequent undue skin-evaporation; whereby the body-temperature may be lower than is good for health, even if persons are well-clothed. The draughtiness is matter of construction, and is obviated by improvement in the methods of ventilation. Then, as to warming. Our present English use of fireplaces is both inefficient and expensive. It might have been expected that, in towns, this plan of warming houses would long ago have been abandoned for some more general use of hot-water or steam pipes. The supply of warmed fresh air is a very simple proceeding when these pipes are used, and thus not only can houses be better warmed, but better ventilated and less draughty. The greater convenience of a furnace serving to heat several houses is not at present appreciated in England; but here and there this consideration has probably contributed to the use of 'flats' in place of separate houses.

3. *Impurity of the air.*—This arises from the following conditions: from the air being drawn from the ground into the house, or passing over impure earth or deposits; or by the air in the house becoming contaminated by effluvia from closets and drain-pipes; from combustion; from respiration and skin-transpiration; from uncleanliness of persons, clothes, walls, floors, and furniture.

Each of these conditions has to be examined into and rectified according to the usual principles laid down in works of hygiene. A few remarks may, however, be permitted on some of the headings.

The removal of respiratory impurities can only be accomplished by constantly removing the air of rooms and supplying fresh air. This is *ventilation*; and, if we include in the definition that the supply and removal of air shall be tolerably uniform, ventilation presents a mechanical problem of no little difficulty. The amount of air required for an adult, in order to keep the air free from any odour, is 3,000 cubic feet per hour; or if the carbonic acid derived from respiration be taken as a measure of respiratory impurity, it should not exceed ·2 per 1,000 volumes of air. Practically, the amount most persons get is not more than 600 to 1,200 cubic feet per hour, if so much, and the air of their rooms smells fusty from organic effluvia. In cold times of the year, the entering air must be warmed, if the change is to be so rapid as is implied in the supply of 3,000 cubic feet of air per hour, equivalent to a change of air in the air-space three, four, or even five times per hour. When warmed to nearly the temperature of the surface of the body (80° to 90° F.) considerable movement of air is borne without difficulty, but if the temperature be much lower a correspondingly slighter movement is felt. Ventilation in this climate is therefore inextricably mixed up with warming, and thorough ventilation of our rooms is impossible so long as we trust to radiant heat alone for warmth. The problem, therefore, which engineers have to solve in warming and ventilating our rooms is, what is the cheapest and most constant plan of introducing warm air, of a temperature of some 80°, into our houses in cold weather; the conditions of the problem being a supply of 3,000 cubic feet per head per hour, at a rate of movement imperceptible to the feelings of the persons in the room.

The second point is connected with the impurity of the air from drains. The first thing is to be certain that the air of the house-drain is so thoroughly disconnected from the air of the public sewers that no reflux from them is possible; and therefore, that, if there is any drain-air polluting the atmosphere of the house, it is not the air of the common sewer. That point having been settled, it will follow that drain-smell in the house must come either from the ground or from the house pipes or closets themselves. If from the ground, there is probably (if the ground itself be clean, or if the smell be of new production) a leaky drain-pipe somewhere, and the air is penetrating through the leakage and is drawn into the house. If not from the ground, the smell may be from some pipe in the house; this arises from imperfect junction, especially when metal pipes are joined on to earthenware, or from the pin-hole eating-away of metal pipes. Or a drain-pipe may be choked (generally through 'settling' at a joint occurring in an ill-laid and badly bedded pipe), and decomposition be going on in its retained contents. Or there may be a clogged or imperfect trap, with the water either sucked out of it or becoming thoroughly charged with fetid effluvia. In the latter cases, there is a presumption that the ventilation of the house-drain is not what it should be. Every house should have a plan of its drainage, so as to facilitate the search for a broken pipe.

In order to detect any of these conditions it is necessary that builders should alter their habits in regard to house-plumbing arrangements. At present they try to conceal everything, so that, without pulling a house to pieces, it is impossible to examine if pipes and traps are in order. Instead of this, every pipe above the ground should be kept out of walls; and if cased with wood, the case should be merely bolted, and not nailed. If a drain must be carried under a house, it should have inspection chambers

built upon it at every change of direction, so that the drain which runs in a straight line from one manhole chamber to the next can be inspected and cleared of obstructions or deposit without breaking into it. The sewage and foul-water arrangements of our houses will never be satisfactory till these matters are attended to, and till the examination of every pipe about the house can be made without difficulty, and clogging or leakage of air or water from pipes can be readily detected.

In closets, the chief points of leakage are in the more horizontal pipes and in the traps. In all cases the soil pipe should be ventilated by pipes carried to the open air at some points away from windows.

Another matter to be guarded against, whether there be drain-smell or not about a house, is the immediate opening of the cistern overflow-pipe, or of the usual rain-water pipe, into the sewer or house-drain. The common practice, until recently, has been to connect them directly with the house-drain, perhaps with an S trap at the foot of each pipe, these traps, however, being usually dry. Then sewer-air passes up and enters the cistern, or into rooms which happen to be near the top of the rain-water pipe. All these pipes should open in free air over a grating; and if every householder would insist on the builder attending to these matters, the chances of inflow of sewer-air into houses would be much lessened.

Another, third, point of importance is the way in which the products of gas-combustion are allowed to pass into the air of rooms. Nothing can be worse than the usual arrangement; and, as gas-lights might be made a valuable means of ventilation if tubes were arranged to carry off the burnt gas, the present arrangement of chandeliers is not only hurtful, but involves an ignorant waste of useful force.

4. *Impurity of the water.*—Water delivered to a house may become impure on the premises, usually from uncleaned uncovered cisterns, absorption of air from drains by the surface of the water, and sometimes by more direct leakage from pipes into cisterns. Lead may also be taken up. The remedies for these conditions are obvious. Reference has already been made to extensive epidemics of enteric fever due to the insuction of matter from sewers into public water-pipes, through fissures in those pipes while running full. It is probable that obscure cases of disease in particular houses are not infrequently due to an unsuspected pollution by similar means of the water-service of the house.

5. *Impurities from uncleanliness of the house.*—Walls and ceilings all absorb impurities which are given out again to the air, and often become highly impregnated with organic matters. The chinks of floors allow matters to collect below them, and then impure air rises into the room.

Of all parts of a house where cleanliness is of importance, there is probably none more important than *larders* and other places where food is stored. It would appear certain that in some cases of food-poisoning the injurious quality has been obtained by storage in places that received sewer-air or other morbific matter. Yet not infrequently any dark unventilated closet is made to serve the purpose of a larder.

The custom of re-papering walls without removing the old paper, the decomposition of paste and paper on damp walls, and the use of arsenical pigments, may give rise to impurities of one and another kind in the air of houses. In the houses of the poor which are not regularly whitewashed, the half-crumbling plaster is often highly charged with animal material.

These matters are to be avoided by original good construction and by constant cleanliness. It is a great desideratum to make walls of impermeable material, so that they may be washed without difficulty; but, at present, this is an expensive matter.

If these various points, which are really questions of purity of air and water, and of temperature and movement of air, are properly dealt with, houses will be healthy. These are conditions which are not difficult to secure if they are clearly understood and if their importance is not underrated. The great point is to have the house-air pure, so as in no way to injure or depress the great function of respiration.

While we look to the Municipality or Local Sanitary Authority to keep the outer air pure, the task of doing the same for the house-air must necessarily fall on the inhabitants of the house.

Duties of the Medical Officer of Health.—It behoves the residents of every district to assist the Sanitary Officers to the best of their ability; and to aid towards such endeavours, this article may usefully conclude by an enumeration of the duties which are imposed upon the Medical Officer of Health for districts in England. They are extracted from an Order of the Local Government Board, dated 1891.

'The following shall be the duties of the Medical Officer of Health in respect of the district for which he is appointed:—

'1. He shall inform himself as far as practicable respecting all influences affecting or threatening to affect injuriously the public health within the district.

'2. He shall inquire into and ascertain by such means as are at his disposal the causes, origin, and distribution of diseases within the district, and ascertain to what extent the

same have depended on conditions capable of removal or mitigation.

'3. He shall by inspection of the district, both systematically at certain periods, and at intervals as occasion may require, keep himself informed of the conditions injurious to health existing therein.

'4. He shall be prepared to advise the Sanitary Authority on all matters affecting the health of the district, and on all sanitary points involved in the action of the Sanitary Authority; and in cases requiring it, he shall certify, for the guidance of the Sanitary Authority or of the Justices, as to any matter in respect of which the certificate of a Medical Officer of Health or a Medical Practitioner is required as the basis or in aid of sanitary action.

'5. He shall advise the Sanitary Authority on any question relating to health involved in the framing and subsequent working of such by-laws and regulations as they may have power to make, and as to the adoption by the Sanitary Authority of the Infectious Disease (Prevention) Act, 1890, or of any section or sections of such Act.

'6. On receiving information of the outbreak of any contagious, infectious, or epidemic disease of a dangerous character within the district, he shall visit without delay the spot where the outbreak has occurred, and inquire into the causes and circumstances of such outbreak; and in case he is not satisfied that all due precautions are being taken, he shall advise the persons competent to act as to the measures which may appear to him to be required to prevent the extension of the disease, and take such measures for the prevention of disease as he is legally authorised to take under any statute in force in the district, or by any resolution of the Sanitary Authority.

'7. Subject to the instructions of the Sanitary Authority, he shall direct or superintend the work of the Inspector of Nuisances in the way and to the extent that the Sanitary Authority shall approve, and on receiving information from the Inspector of Nuisances that his intervention is required in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall, as early as practicable, take such steps as he is legally authorised to take under any statute in force in tho district, or by any resolution of the Sanitary Authority, as the circumstances of the case may justify and require.

'8. In any case in which it may appear to him to be necessary or advisable, or in which he shall be so directed by the Sanitary Authority, he shall himself inspect and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vogetables, corn, bread, flour, or milk, and any other article to which the provisions of the Public Health Act, 1875, in this behalf shall apply, exposed for sale, or deposited for the purpose of sale or of preparation for sale, and intended for the food of man, which is deemed to be diseased, or unsound, or unwholesome, or unfit for the food of man; and if he finds that such animal or article is diseased, or unsound, or unwholesome, or unfit for the food of man, he shall give such directions as may be necessary for causing the same to be dealt with by a Justice according to the provisions of the statutes applicable to the case.

'9. He shall perform all the duties imposed upon him by any by-laws and regulations of the Sanitary Authority, duly confirmed where confirmation is legally required, in respect of any matter affecting the public health, and touching which they are authorised to frame by-laws and regulations.

'10. He shall inquire into any offensive process of trade carried on within the district, and report on the appropriate means for the prevention of any nuisance or injury to health therefrom.

'11. He shall attend at the office of the Sanitary Authority or at some other appointed place, at such stated times as they may direct.

'12. He shall from time to time report in writing to the Sanitary Authority his proceedings, and the measures which may require to be adopted for the improvement or protection of the public health in the district. He shall in like manner report with respect to the sickness and mortality within the district, so far as he has been enabled to ascertain the same.

'13. He shall keep a book or books, to be provided by the Sanitary Authority, in which he shall make an entry of his visits, and notes of his observations and instructions thereon, and also the date and nature of applications made to him, the date and result of the action taken thereon, and of any action taken on previous reports; and shall produce such book or books, whenever required, to the Sanitary Authority.

'14. He shall also make an annual report to the Sanitary Authority, up to the end of December in each year, comprising a summary of the action taken, or which he has advised the Sanitary Authority to take, during the year, for preventing the spread of disease, and an account of the sanitary state of his district generally at the end of the year. The roport shall also contain an account of the inquiries which he has made as to conditions injurious to health existing in the district, and of the proceedings in which he has taken part or advised under any statute, so far as such procoedings relate to those conditions; and also au account of the supervision exercised by him, or on his advico, for sanitary purposes over places and houses that the Sanitary Authority have power to regulate, with tho nature and results of any proceedings which may have

been so required and taken in respect of the same during the year. The report shall also record the action taken by him, or on his advice, during the year, in regard to offensive trades, to dairies, cow-sheds, and milk-shops, and to factories and workshops. The report shall also contain tabular statements (on forms to be supplied by us [Local Government Board], or to the like effect) of the sickness and mortality within the district, classified according to diseases, ages, and localities.

'Provided that, if the Medical Officer of Health shall cease to hold office before the thirty-first day of December in any year, he shall make the like report for so much of the year as shall have expired when he ceases to hold office.

'15. He shall give immediate information to us of any outbreak of dangerous epidemic disease within the district, and shall transmit to us a copy of each annual report and of any special report. He shall make a special report to us of the grounds of any advice which he may give to the Sanitary Authority with a view to their requiring the closure of any school or schools, in pursuance of the Code of Regulations approved by the Education Department, and for the time being in force.

'16. At the same time that he gives information to us of an outbreak of an infectious disease or transmits to us a copy of his annual report or of any special report, he shall give the like information or transmit a copy of such report to the County Council or County Councils of the county or counties within which his district may be situated.

'17. In matters not specifically provided for in this Order, he shall observe and execute any instructions issued by us, and the lawful orders and directions of the Sanitary Authority applicable to his office.

'18. Whenever we shall make regulations for all or any of the purposes specified in section 134 of the Public Health Act, 1875, and shall declare the regulations so made to be in force within any area comprising the whole or any part of the district, he shall observe such regulations, so far as the same relate to or concern his office.'

EDMUND A. PARKES. GEORGE BUCHANAN.

PUERILE (*puer*, a boy).—This word is associated in medicine with the respiratory murmur when it is exaggerated, possessing the characters heard over the lungs in a healthy child. *See* PHYSICAL EXAMINATION.

PUERPERAL DISEASES. — The diseases associated with parturition, which fall for consideration in the present article, are: (1) Puerperal Convulsions; (2) Puerperal Fever; (3) Puerperal Peritonitis; and (4) Puerperal Thrombosis and Embolism. Certain other pathological conditions of equal importance, occurring during the puerperal state, are more conveniently discussed under their several special names. *See* PELVIC ABSCESS; PELVIC CELLULITIS; PELVIC PERITONITIS; and PHLEGMASIA DOLENS. Puerperal insanity is described in the article INSANITY, Varieties of.

1. Puerperal Convulsions.—SYNON.: Puerperal Eclampsia; *Eclampsia Gravidarum, Parturientium, vel Puerperarum*; Fr. *Convulsions des Femmes Enceintes et en Couche*; Ger. *Eklampsie in der Schwangerschaft und im Wochenbett.*

DEFINITION.—A peculiar kind of epileptiform convulsions, characterised by loss of consciousness and sensibility, together with tonic and clonic spasms; occurring in the later months of pregnancy, during labour, or after delivery; and causing great danger to the lives of both mother and child.

ÆTIOLOGY.—The frequent association of this disorder with albuminuria had till lately given rise to the belief that it is the result of uræmia; and notwithstanding that cases have been observed in which albumen was present in the urine in large quantity without convulsions occurring, and others in which the eclamptic attacks took place without any albumen, or a mere trace only, being present, it is probable that *insufficiency of the kidneys* is by far the most frequent, if not the invariable cause. The writer has no doubt that twin pregnancy is a not infrequent cause of albuminuria, from the many cases of it which have come under his personal observation.

Traube and Rosenstein have referred the causation of the convulsions to acute cerebral anæmia, resulting from changes in the blood incidental to pregnancy, the watery condition of the blood being associated with increased tension of the arterial system. The late Dr. Angus Macdonald, of Edinburgh, pointed out that he had discovered by *post-mortem* examination extreme anæmia of the cerebro-spinal centres, with congestion of the meninges, without œdema. He attributed the convulsive attacks to irritation of the vaso-motor centre, from an anæmic condition of the blood, produced by the retention in it of excrementitious matters which should have been eliminated by the kidneys. In 1889 M. Emile Blanc found in the urine of eclamptic patients a microbe with intense pathogenic effects and well defined. He extended his researches to the albuminuria of pregnancy, and examined and made cultures of the blood and urine. These researches demonstrated a microbe in the form of a short bacillus having at its two extremities depressions analogous to nuclei. With 45 minims of a culture furnished by the blood of an eclamptic, a rabbit eighteen days pregnant was inoculated. She died in twelve hours with intense convulsive phenomena, having dropped one or two of her young dead.

Symptoms.—Puerperal eclampsia is happily not of common occurrence, its estimated frequency being about once in 500 cases. Occasionally the outbreak occurs without warning, but usually there are premonitory symptoms. The most frequent of these is œdema of the feet and legs, which may extend to the vulva, abdomen, face, and upper extremities, and should at once suggest an examination of the urine, which will almost invariably be found to contain albumen in more or less quantity, with a diminution in the amount of urea which should be excreted. Sometimes casts may be found. The writer has had under his observation a case in which œdema of the feet and ankles occurred without a trace of albumen in the urine, though later it appeared in abundance, and the patient died of eclampsia during labour. Other premonitory symptoms are headache, generally frontal, but occasionally limited to one side; vertigo; loss of memory; and derangements of vision, such as amblyopia, and flashes of light before the eyes.

When the convulsive seizure occurs it cannot be mistaken. The eyes first become fixed, and rapid contraction of the muscles of the face occurs, with rolling of the eyeballs, the pupils being lost under the upper eyelids. The face becomes turned first towards one shoulder, then towards the other. The convulsions rapidly extend to the other parts of the body; after a short period of tonic contraction violent clonic spasms occur. The face becomes livid, the tongue is protruded, and, if care be not taken, it is lacerated by the teeth, colouring the frothy saliva which has been emitted at the angles of the mouth. The thumbs become clenched in the palms, and violent jerkings of the arms occur, whilst the muscles of the face give rise to a variety of contortions. Sometimes involuntary evacuations of the bladder and rectum occur during the fit. There is total loss of consciousness and sensation. After a few minutes the symptoms gradually subside; a longer interval occurs between the clonic muscular contractions; the face loses its lividity; and the breathing becomes more tranquil. When the first fit has passed off, the patient may recover her consciousness; but if another occur with rapidity, and very little time elapse between the paroxysms, complete coma resulting in death may soon supervene. Where there is a considerable time between the attacks, it may be many hours or days before consciousness is restored, and recovery takes place. A remarkable feature of this disorder is that when the patient becomes sensible, and is restored to health, she has invariably no recollection of what occurred, not only during her illness, but for some time preceding the fits.

Prognosis.—This depends upon the severity and frequency of the paroxysms. It is generally considered that one in every three or four cases proves fatal. The earlier the convulsions appear in labour, the more unfavourable the prognosis. The longer the labour and the more difficult the delivery, the deeper is the coma and the less the prospect of recovery. It is very rare for the convulsions to cease before the birth of the child. The mortality has probably diminished of late years, since indiscriminate venesection has been abolished, and other treatment adopted.

Treatment.—Recognising that 'prevention is better than cure,' we must first consider what is best to be done when premonitory symptoms arise. The occasional examination of the urine of pregnant women is always a wise precaution, but it is urgently called for whenever œdema of the feet or other parts is noticed. Slight traces of albumen are not infrequent, and are of no importance; but persistent albuminuria to any considerable amount calls for most careful watching and treatment, and the amount of urea passed in the twenty-four hours should be ascertained. A milk diet, and the administration of diuretics and iron, with mild laxatives, should be tried; but, if little or no improvement takes place, the question of induction of premature labour should be discussed, and the writer from his own observations is very strongly in favour of it. He has in a large number of cases adopted it without the occurrence of eclampsia, both mothers and children being saved; whereas he has seen instances in which, after consultation, it was decided to leave it till labour took place naturally, and the result has been eclampsia and death.

If convulsions arise, chloroform should be administered at once, and should be repeated at each succeeding attack, while an enema of thirty grains of chloral and the same amount of bromide of potassium may be given to lessen the amount of chloroform subsequently needed. If the labour proceed well, it should be allowed to take its own course; but if it be tardy, and the forceps can be applied, it should be employed to expedite delivery, though caution should be exercised not to extract the child in too great a hurry. The hypodermic injection of pilocarpine has been employed, in the hope that the diaphoresis produced might relieve the arterial tension; but the results are anything but encouraging, and it cannot be recommended. Venesection, which used to be the universal treatment, is now very rarely adopted. There are, however, cases in which it is undoubtedly called for: in women of plethoric habit, with congested face and full pulse, showing much arterial tension, it will probably be found of great benefit.

When the convulsive attacks occur or continue after labour, hypodermic injections of morphine, although condemned by some writers on account of the renal condition, have been found to act well.

2. Puerperal Fever.—Synon.: Childbed Fever; Puerperal Septicæmia; Fr. *Fièvre Puerpérale*; Ger. *Puerperalfieber*; *Kindbettfieber*.

Definition.—A continued fever of a contagious character, occurring in connexion with childbirth.

Pathology and Ætiology. — Numerous theories and hypotheses have been suggested in regard to the nature and relations of puerperal fever, but it is now generally accepted that it is a disease of traumatic origin, resulting from septic matter coming into contact either with the inner surface of the uterus, where, after delivery, dilated veins and lymph channels abound, or with some part in the genital tract where lesions exist, which are very commonly produced during labour. The septic virus, though generally introduced from without, may arise within the parturient canal itself, putrefaction going on in it (*auto-sepsis*); and retained portions of placenta or membrane may perhaps be concerned in this. In such cases the onset of the disease is not generally so violent as when the poison has been introduced from without, during labour, by those coming into contact with the patient, through the medium of their clothes or of their hands, or by means of sponges or instruments such as catheters. Other external sources may be the bedding, sheets, or diapers; or possibly the air itself may carry the poison to the wound, where septicæmia is present in the same dwelling as the parturient woman—in lying-in institutions, for example.

Semmelweis, in 1847, was the first to demonstrate how in the General Hospital, Vienna, those making *post-mortem* examinations and subsequently engaged in the midwifery wards conveyed infection to the patients through the medium of cadaveric matter on their hands. This led, at his suggestion, to the employment of antiseptics in midwifery practice; and there is no doubt that to this may be attributed in great measure the remarkable change that has taken place in the rate of mortality in the lying-in hospitals. The writer, in the *Lancet* of April 1, 1893, in a short paper on 'Antiseptic Midwifery,' pointed out how, in the City of London Lying-in Hospital, where the death-rate for a long period of years had averaged over 2 per cent., it had, since the antiseptic management had been properly carried out, fallen to 0·31 per cent., the average of the last six years; and that during a period which has just reached two years upwards of 950 women had been delivered in the institution without a single death from any source whatever. No stronger evidence could be adduced to show that lying-in hospitals, formerly regarded as dangerous to enter, may now be looked upon, under proper management, as the safest places to be *confined* in.

Anatomical Characters. — Septicæmia may assume the lymphatic or the venous form, according to which of these channels it selects to diffuse itself through the body, and it may kill so rapidly as to leave no local manifestations of disease. But if the vagina is severely affected, the mucous membrane looks soft and infiltrated, and lacerated parts are usually covered by a discoloured membrane. The cervix uteri, which is so frequently the seat of injury during labour, may become inflamed, and suppuration occur in the cellular tissue which surrounds it. The interior of the uterus is often covered with a coagulated exudation. The pelvic cellular tissue probably becomes affected. The peritoneum is almost certainly involved, and a coagulated exudation or fluid pus is found in the folds around the uterus, in Douglas's pouch and elsewhere, or the peritonitis may be diffuse, and associated with pleurisy and pericarditis and effusions into the joints. If the absorption has taken place through the veins, broken-down thrombi will be found, and from these embolic foci and abscesses may occur in the lungs; the spleen is almost always enlarged, and embolic infarcts may be found in it, as well as in the kidneys. Endocarditis and meningitis may arise; and sometimes, though rarely, destruction of the eyeball.

Symptoms.—In no disease do the symptoms vary more than in puerperal fever, depending upon the violence of the fever, and the localities attacked by the poison. The fever generally originates within three days after delivery, though sometimes later, very rarely after the fifth day. Occasionally there is, first of all, a feeling of depression, with headache; often the first symptom is a rigor. The pulse becomes rapid and feeble, 130 or more per minute. The temperature rises to 103° F., or higher. The skin is generally hot and dry. Vomiting frequently occurs early, the ejecta being like coffee-grounds, and of a peculiar odour. Diarrhœa is often very troublesome, and the evacuations are horribly fetid. The tongue soon becomes coated with a heavy fur, later on becoming dry and raspy; and sordes appear on the lips. There is often acute pain in the abdomen, with tenderness and swelling; but peritonitis with effusion may occur without any of these symptoms. Sometimes the swollen, tender uterus can be felt in the hypogastrium. The lochia are generally suppressed, and the secretion of milk arrested, though sometimes the mammæ are hard and painful. As a rule, the intellect is unimpaired, though low muttering delirium frequently precedes death. The breathing is short and hurried. Pneumonia, pleurisy, or pericarditis occasionally ensues. Jaundice or albuminuria may be present. The joints may swell and suppurate; and abscesses may form in any part of the body.

Course and Terminations.—The disease, if of the lymphatic variety, begins very early, and generally runs a rapid course, terminating fatally within a week. The pulse becomes more and more rapid and feeble; the breathing more hurried and panting; tympanites sets in; a cold clammy sweat breaks out; finally hiccough, subsultus, and low muttering delirium come on, with frequently incessant vomiting; and the patient sinks from exhaustion. The venous variety generally shows itself much later, is of much longer duration, and is associated with erratic rigors, and an absence of abdominal distension.

Treatment.—(1) *Prophylactic.*—This is of the utmost importance. Keeping in mind the sources of the disease, it behoves the practitioner to avoid every means of communicating septic matter to the patient, either personally or by the nurse. If possible to arrange it, the genital organs should never be touched without the hands having been first thoroughly rinsed in an antiseptic solution of either carbolic acid, corrosive sublimate, or tincture of iodine. All sponges should be thoroughly cleansed before use in an antiseptic solution; so also all instruments, such as irrigation tubes, the forceps, or catheters. The catheter and vaginal tube should be made of glass or translucent celluloid, which enables one to see that no blood or clot is retained within them. Instead of cold cream, a preparation containing 1 drachm of absolute carbolic acid to 2½ oz. of benzoated lard should be employed for lubricating the examining finger, and it should be introduced into the vagina as seldom as possible. The utmost care should be observed to avoid the smallest piece of the placenta or membrane being left within the uterus. Subsequently all washings or syringings of the genitals should be performed with a solution of carbolic acid (1 to 40), or, what is still more reliable, a solution of perchloride of mercury of the strength of 1 in 2,000. It is a very good plan to give a vaginal injection of this at a temperature of about 115° F. in every case where it is practicable after the placenta has been removed, and before the binder is applied, and to repeat this night and morning during the two or three days following delivery. The practitioner should, when able, order all these preparations to be in the house previous to the expected time of delivery.

(2) *General.*—The general treatment varies with the character of the disease. At first active antiphlogistic remedies may be indicated; and in some cases local depletion by leeches, in other cases blisters. Drugs, such as veratrum viride (much employed in America), aconite, digitalis, or salicylic acid, may be useful in lowering the temperature. The internal administration of turpentine has been highly extolled; this drug is often very efficacious when applied on hot flannel to the abdomen, or used as an enema where there is much tympanites. Opium, or morphine, is invariably demanded to subdue restlessness, allay pain, and induce sleep. Laudanum, applied in poultices to the abdomen, is sometimes very grateful to the patient. When, however, there is much tenderness and distension, a paste composed of two parts of extract of belladonna to one of glycerine, brushed thickly over the whole abdomen, will be preferable. Quinine is often of great value in diminishing the fever; it may be given in doses of 5 grains or more every four or six hours. Warburg's tincture may answer still better. If the discharges are fetid, an intrauterine antiseptic douche should be employed with great caution, usually only on one occasion, to be followed night and morning by the vaginal douche. In cases of a more chronic type, where diarrhœa is a prominent symptom, tincture of perchloride of iron in large doses, 20 to 30 minims, is sometimes very serviceable. One of the most important elements in the treatment of this exhausting disease is the frequent administration of nutritious food and stimulants—strong beef-tea, milk, eggs, champagne or brandy—in small quantities at short intervals. In cases of obstinate vomiting recourse must be had to nutrient enemata; and nutrient suppositories are often of great use, employed alternately. The most abundant supply of fresh air that can be admitted with safety should be secured.

It is impossible to map out any distinct line of treatment for puerperal fever. Each case must be combated according to its individual symptoms, and demands constant attention; for, though the disease is fearfully fatal, some of the apparently most hopeless cases recover.

3. Puerperal Peritonitis.—This, though one of the most frequent complications of puerperal fever, sometimes occurs independently of it, other symptoms than those consequent upon the local inflammatory attack being absent. It may arise from the rupture of a Fallopian tube distended with pus—a pyosalpinx; or from some uterine lesion occurring during labour.

Anatomical Characters.—The *post-mortem* appearances associated with puerperal peritonitis differ from those described in connexion with puerperal septicæmia only inasmuch as they are confined to the peritoneal cavity. There will probably be found an abundance of effused serum or sero-pus, and flaky lymph, and intense congestion of the peritoneum; and the abdominal viscera will here and there be glued together. The uterus will probably be found preternaturally soft.

Symptoms.—Generally within a week following delivery a well-marked rigor occurs, followed by febrile disturbance. The patient complains of acute pain in the lower part of

the abdomen, at first in one particular spot, but soon spreading over a larger area. The thighs become flexed on the abdomen to relieve the tension; the belly becomes much swollen, and excessively tender; and there is generally much tympanites, with obstinate constipation. The pulse is very characteristic, being quick, wiry, and incompressible. Vomiting soon sets in. If the disease do not give way, the abdomen becomes more swollen and tense, and no pressure upon it can be borne. Everything that is taken is vomited; the pulse becomes more rapid and feeble; the tongue is dry and raspy; the constipation gives way to diarrhœa; the skin becomes clammy, and the extremities cold; and the patient dies.

Treatment.—The application of leeches to the abdomen, immediately the tenderness is complained of, may be of much service in subduing the local inflammation and allaying pain. Opium is the drug of all others to be relied upon. Hot fomentations and counter-irritants, such as turpentine, often give great relief. In the first stage a copious enema of thin gruel with castor oil, to obtain a free action of the bowels, should be given. Where there is much tympanites, the addition of turpentine may be of benefit in dispelling the flatus. If vomiting prevent nourishment being taken by the mouth, it should be administered *per rectum*. Surgical treatment by abdominal incision, and flushing out the peritoneal cavity, may in some cases afford the best chance of recovery.

4. Puerperal Venous Thrombosis and Embolism.

Definition.—The occurrence of a blood-clot in the right side of the heart or pulmonary arteries, either formed *in situ* or conveyed there from a distance by the blood-current, often giving rise to sudden death after delivery.

Anatomical Characters.—The condition of the blood in pregnancy and the puerperal state renders it liable to form a coagulum, and this may occur in distant vessels. It is well known that in the later months of pregnancy the amount of fibrin in the blood is very greatly increased. Together with this, a diminution in the volume of the blood from uterine hæmorrhage produces a state of exhaustion, which causes a great predisposition to thrombosis. If, therefore, such having occurred in distant vessels, a portion of coagulum become detached, and be carried away till it reach the pulmonary arteries, embolism is the result, and this is one of the great causes of sudden death occurring after parturition. It has been shown, however, that pulmonary thrombosis may occur independently of embolism; large, firm, decolorised coagula have been found, on *post-mortem* examination, occupying the right side of the heart and the larger branches of the pulmonary arteries, which have evidently formed there, all traces of thrombosis elsewhere being absent.

Symptoms.—These are common both to embolism and pulmonary thrombosis. In the great majority of cases, the patient is suddenly seized with severe dyspnœa; she starts up and gasps for breath; the face in some cases has been described as pale, in others livid. She feels she is dying, and calls out for air; the pulse becomes almost imperceptible; and generally death occurs very rapidly. If the patient be examined during the attack it is probable that a murmur will be heard over the site of the pulmonary artery. In some cases in which the clot is not sufficiently large to entirely obstruct the circulation in the lungs, it appears that absorption may ultimately take place, and recovery ensue. Dr. Playfair has published some cases which support this view.

Treatment.—In almost every case so rapidly fatal is the seizure that there is no time to think of treatment. When, however, the attack is not so terribly rapid in its termination, every effort must be made to rally the patient, by the administration of stimulants, such as brandy, ether, or ammonia, if at hand. The most perfect rest must be enjoined, so as to prevent the coagulum from becoming dislodged, and to promote its absorption. Sir B. W. Richardson has recommended solution of ammonia in large doses, with a view of dissolving the fibrin.

Clement Godson.

PUERPERAL INSANITY. — *See* Insanity, Varieties of.

PULLNA, in Austria. — Sulphated waters. *See* Mineral Waters.

PULMONARY APOPLEXY. — A term for a certain form of hæmorrhage into the lungs. *See* Lungs, Hæmorrhage into.

PULMONARY DISEASES. — *See* Lungs, Diseases of.

PULMONARY MURMUR. — This word may be employed in two senses, namely, as signifying, first, the respiratory sound heard over the lung; or, secondly, a bruit heard in connexion with the pulmonary artery and its valves. *See* Heart, Valves and Orifices of, Diseases of; Physical Examination; and Pulmonary Vessels, Diseases of.

PULMONARY VALVES AND ORIFICES, Diseases of.—*See* Heart, Valves and Orifices of, Diseases of; and Pulmonary Vessels, Diseases of.

PULMONARY VESSELS, Diseases of.—The vessels of the pulmonary circulation, more especially the veins, enjoy a considerable immunity from disease. Primary affections of these vessels are of most

exceptional occurrence, and the causes leading to their being secondarily involved are not numerous. It is not easy to account for this. The pulmonary arteries much less often present those diseased states which are of frequent occurrence in the arteries of the systemic circulation. and are not even as commonly affected as the systemic veins, with which they somewhat more closely agree in point of structure, and in the kind of blood carried by them. The portal vein, which is comparable to the pulmonary artery in other respects besides its plan of distribution. would appear to be similarly free. For these reasons affections of the pulmonary vessels are rather of pathological interest than clinical importance; in the majority of cases they are not to be recognised during life, or, if so, are beyond the application of any treatment. The trunk of the artery, and especially the orifice in the right ventricle, is singularly liable to present congenital abnormalities, which are treated of in the article HEART, Malformations of.

The diseases of the pulmonary artery will now be discussed in the following order: (1) Inflammation; (2) Degenerations; (3) Ulceration; (4) Dilatation and Aneurysm; (5) Stenosis; (6) Rupture; and (7) Embolism and Thrombosis.

1. **Inflammation.** — ÆTIOLOGY. — Acute arteritis affecting the pulmonary artery is of very rare occurrence, and usually co-exists with acute endocarditis. Previous to birth it seems to be more liable to exist than subsequently, and some of the congenital deformities of the pulmonary artery and its valve are to be attributed to it. After birth it is almost invariably associated with such acute blood-diseases as pyæmia, or with those pyrexial states which are apt to assume a septic character, as scarlet fever. Emboli, especially if of a putrid character, which have become lodged in branches of the vessel, are liable to set up inflammation in the contiguous walls. Chronic arteritis, leading to atheroma, though far less frequent than in the aorta, is not of very rare occurrence, and under very much the same conditions, namely, increased strain of the vessels, associated with obstruction to the pulmonary circulation, and an hypertrophied right ventricle. When the vessels have become much dilated, as from extreme mitral stenosis, the walls thus thinned are liable to undergo changes of a chronic inflammatory character. *See* ARTERIES, Diseases of.

ANATOMICAL CHARACTERS. — These correspond with the usual characters of arteritis. The process begins in the sub-epithelial layer of the inner coat, and results in the formation of a variety of connective tissue, which consists of fibres, fusiform fibre-cells, and homogeneous material; these constituents being developed in varying proportions, and forming patches of grey, gelatinous or semi-cartilaginous material. The new-formed tissue within the thickness of the walls tends to break down and form an atheromatous abscess, which, bursting into the lumen of the vessel, leaves an ulcerated surface, though this is far less common than in the aorta. Or the yellowish patches of atheroma may become calcareous. A peri-arteritis, consisting of a fibroid thickening limited to the adventitia, has been met with in the vessels of limited areas of the lung; it is perhaps of syphilitic origin.

This state is only demonstrable after death; during life it is not recognised, unless the valves be affected, by any known signs or symptoms, and a diagnosis of its existence has not hitherto been attempted. Under such circumstances no plan of treatment can be laid down.

2. **Degenerations.**—(*a*) *Fatty.*—Primary fatty degeneration of the deeper layers of the intima, without any previous inflammation, occurs in the pulmonary, as in other arteries. It appears to be commoner when there is obstruction to the circulation through the lungs, and when considerable in amount forms yellowish irregular spots, which may subsequently involve the middle coat, and form in the thickness of the wall masses of softened fatty matter, which finally bursts into the vessel.

(*b*) *Lardaceous degeneration.* — This has been recorded as having been seen in the muscular coat of branches of the pulmonary artery.

3. **Ulceration.**—As already said, inflammation of the vessel-walls very rarely extends to ulceration of the inner coat, but owing to the extreme frequency of ulcerative destruction of the lung-tissue, the intra-pulmonary branches of the vessels are constantly involved. Phthisis, abscess, or gangrene of the lungs, may each in their progress invade the vessels, the walls of which, though offering considerable resistance to the destructive process, sooner or later yield, and may cause a fatal hæmorrhage, though very frequently a loss of blood is prevented by blocking up of the vessels with coagula.

4. **Dilatation and Aneurysm.**—ANATOMICAL CHARACTERS.—Varying changes of abnormal distension are not unusual, occurring in both sexes and in all ages beyond childhood, and are estimated as forming ·3 per cent. of aneurysms of all kinds. The dilatation may affect the trunk uniformly; and an extreme case has been recorded where the circumference of the vessel attained 6½ inches, the normal average being taken at 3½ inches. Or, limited in extent, the bulging forms a sacculated, or, more rarely, a dissecting aneurysm of the trunk or branches, from the size of a walnut to a pea, or even smaller, these latter being frequently multiple. The conditions which lead to these alterations in the normal calibre of the vessel are—(*a*)

Those causing a diminished resistance of their coats to the blood-pressure, especially if this be increased, which is often the case, by obliteration of some vessels, and consequent rise in tension in the remaining ones; or by general obstruction, such as mitral stenosis or emphysema would cause. (*b*) Those changes in the lung-structures which diminish the support of the vessels, and so allow of their yielding. The results of arteritis and atheroma will furnish the first condition, and ulceration and destruction of the pulmonary tissue will provide the latter. The trunk of the artery has been frequently found unduly dilated in anæmia. The walls of true aneurysms may be thicker or thinner than those of the healthy vessel, and it is remarkable that their contents are said to be never laminated coagula, even in the largest, but always fresh clots.

An extreme case of distension of the pulmonary veins is recorded (*Dublin Journal*, 1832), especially the left, where the vessels were dilated to four times their normal size, owing to extensive obstructions at their openings into the left auricle.

Symptoms.—When the main trunk of the pulmonary artery is the seat of an aneurysmal tumour, there are the usual signs of pulsation and prominence in variable degrees, most marked to the left of the sternum in the second intercostal space; over the same area a systolic bruit of a superficial quality is to be heard, not conducted above the sternum or clavicles; and a systolic thrill is to be felt. There is also accentuation of the second sound, with the signs of hypertrophy of the right ventricle. Should the tumour be of any considerable size, it will give rise to those conditions which commonly follow an obstruction to the pulmonary circulation—namely, lividity, dyspnœa, cough, and general anasarca, with scanty, high-coloured urine; and symptoms of pulmonary embolism may result from detachment of fragments of clot from the sac. In an exceptional case, pallor of the face was noticed. Pain behind the sternum, and headache, also exist. Since the greater part of the artery is included within the pericardium, it is into that sac that rupture will probably occur. Uniform dilatation of the trunk of the artery may be accompanied with sufficient stretching of the cardiac orifice to cause regurgitation into the ventricle.

The small aneurysms of the intra-pulmonic branches give rise to no known symptoms until hæmoptysis indicates their rupture.

Diagnosis.—An aneurysm of the trunk of the pulmonary artery may have to be distinguished from a similar affection of the aorta, or from a post-sternal tumour to which pulsation has been communicated. The tendency of pulmonary aneurysm to extend to the left side, and the non-conduction of the bruit to the vessels at the root of the neck, with the coincident signs of pulmonary obstruction, are grounds upon which to found a distinction, though the distinction from an aortic aneurysm is not always easy.

Prognosis.—This is of necessity grave, whatever the size of the lesion, and many cases of fatal hæmoptysis are due to rupture of a small-sized sac.

Treatment.—How far such treatment as galvano-puncture, the administration of iodide of potassium, &c., as pursued in aneurysm of the systemic vessels, is applicable to similar affections of the pulmonary artery, is unknown. For the treatment of the hæmorrhage to which rupture of the smaller aneurysms gives rise, *see* Hæmoptysis.

5. **Stenosis.**—A narrowing of the pulmonary artery may take place at the orifice, in the conus arteriosus, or more rarely in the trunk or main branches. In the former situations it is commonly congenital, the result of endocarditis or myocarditis, which, if developed within the first three months of fœtal life, is almost invariably accompanied by some compensating lesion, such as intra-ventricular communication; whilst if the affection of the heart be subsequent to the third month of development, the circulation is carried on through a patent foramen ovale and ductus arteriosus (*see* Heart, Malformations of). It is conceivable that stenosis of the conus arteriosus may be followed by secondary narrowing and closure of the pulmonary artery, and also that defective development of the lungs may cause a narrowed vessel. The condition is very rarely due to any acquired change in the vessel-walls, although a case is recorded of stenosis of the artery from cartilaginous thickening and calcification of its coats. The calibre of the tube may be diminished by the pressure of tumours, such as an aortic aneurysm or adenoid growths, or by the shrinking of cicatricial tissue in the adjacent lungs, or from arteritis following on direct violence.

When stenosis is developed at a very early period of fœtal life, the artery remains exceedingly narrow beyond the obstruction. When it occurs late, the vessel may be of normal capacity, and if insufficiency co-exist with the obstruction, it may even be dilated.

Symptoms.—Whatever be the cause of pulmonary stenosis, there will be a deficient supply of blood to the lungs, producing dyspnœa, and the obstruction to the circulation will give rise to all the signs and symptoms of general venous congestion, although to a less degree than in affections of the tricuspid orifice. Hypertrophy of the right ventricle—as evidenced by increased transverse measurement of the area of cardiac dulness, and a forcible impulse felt at the epigastrium, a basic thrill, a systolic bruit, of maximum intensity over the heart's base, and conducted to the left of the sternum, but

not audible along the course of the aorta and great vessels, and a marked accentuation of the second sound—is the most important result of this condition. Cyanosis is not a characteristic, and does not occur unless there be extreme venous congestion, or a communication between the two sides of the heart. The association of constriction of the pulmonary artery, both congenital and acquired, with tubercular phthisis, has now been too frequently observed for it to be regarded as a coincidence only, and their relation as cause and effect is generally admitted.

Treatment. — This affection is entirely beyond the reach of remedy.

6. **Rupture.** — Violent effort and great excitement have been followed by rupture of the pulmonary artery, either of the trunk or main branches, when degenerated. Death is often instantaneous, though it may be delayed even some hours. Aneurysms tend to burst sooner or later; those of the trunk usually opening into the pericardium, while the intra-pulmonary dilatations commonly rupture into cavities in the lung. Ulceration, as said, is of very rare occurrence, but a case is recorded of its existence and extension through all the coats of the vessel, with a suddenly fatal termination. Rupture of the pulmonary veins has been recorded.

7. **Embolism and Thrombosis.**—The pulmonary artery is especially liable to become plugged, both by substances lodged in it from elsewhere, and by coagula originating in the vessel itself. Its relationship to the venous circulation explains this. Portions of broken-down clots developed in the systemic veins, from whatever cause; the contents of hydatid and other cysts that have burst into the venous current; fragments of cancerous and other new-growths, all of which readily travel onwards towards the heart, pass into the pulmonary artery, in the branches of which they become lodged, according to their size. Once located, the plug will increase in size by the deposition on it of successive layers of fibrin, sometimes to such an extent as to obliterate all traces of the original obstructing substance. Occasionally very large thrombi are detached in the systemic veins, and are arrested in the trunk and main branches of the pulmonary artery. The causes of thrombosis of the vessel are various. The rare occurrence of inflammation or degeneration of the artery renders obstruction of the vessel from primary thrombosis very uncommon; but the development of clots in the smaller branches, in association with pneumonia, phthisis, gangrene, and other destructive lung-diseases, is frequent. In certain septic states, in severe malarial states, in parturient women, and in conditions of extreme anæmia, especially with diminished heart-power, when the blood is prone to clot in the vessels, the pulmonary artery is a favourite locality for this to occur; though the not unusual occurrence of this condition in women after delivery is more probably embolic in character. Pressure on the pulmonary artery or its main divisions by aortic aneurysm, enlarged glands, or other mediastinal tumours, has been known to cause the formation of a thrombus in the vessel. Thrombi may commence in the right ventricle, or, as would appear, sometimes on the semilunar valves, and extend into the trunk and, for variable distances, into the branches of the vessel. Such obstructions are frequently developed during the last hours of life, when the circulation is enfeebled and slow. *See* Embolism; Heart, Thrombosis of; and Lung, Hæmorrhage into.

Symptoms.—The symptoms will, of course, depend upon the extent and completeness of the obliteration of the pulmonary circulation. If only the smaller branches be occluded, the symptoms may be those of pulmonary infarction, and the very moderate dyspnœa or slight hæmoptysis might be equally attributable to the phthisis or other lung-state which had determined the formation of the thrombi.

In another class of cases, when larger branches are blocked, very marked dyspnœa is developed, with such symptoms as are conveniently grouped under the term 'anginal,' such as pain in the præcordia, a sense of great distress and faintness, palpitation, gasping, lividity, and extreme pallor, with cold sweats, but no loss of mental faculties, though often inability to speak, an almost imperceptible rapid or irregular pulse, and jactitation of the limbs. The onset of such a condition may be gradual or sudden; in the former case it depends on the slow increase in size of a small thrombus; in the latter, on the sudden lodgment in some large branch of the artery of a solid substance that has entered the venous current. In some cases these symptoms are present to an extreme degree, and death follows in a few minutes; in fact, this lesion constitutes one of the causes of sudden death. The appearances are not those of asphyxia, and it is usual to attribute the very rapidly fatal result to syncope or shock, as it would seem to be connected in some way with an arrest of the nerve-governance of the heart. In that class of cases which do not terminate so quickly, it is usual to find that the symptoms abate somewhat, and may be followed at a variable interval of hours, days, or even months by a second or even several attacks, usually ending fatally. The *post-mortem* examination of such cases shows a thrombus of considerable extent, with indications of its having been formed at different times.

Examination of the chest reveals no diagnostic signs. There is very likely to be a basic systolic murmur conducted along the course of the pulmonary artery; but this is

not constant, and the heart-sounds are oftener muffled and indistinct.

Diagnosis.—This is often very uncertain. The conditions in which thrombosis is usually met with, such as in anæmic or parturient women, are those in which breathlessness, cardiac pain, and discomfort, and even a pulmonary hæmic bruit, are of frequent occurrence. The symptoms, when not of extreme rapidity, are very similar to those caused by stenosis of the pulmonary artery, which in itself is difficult to diagnose; and, lastly, the suddenly fatal cases are almost identical in their manifestations with rupture of the heart or of a thoracic aneurysm, or even angina pectoris. The supervention of the above-detailed symptoms in a case of existing phlebitis, in a woman within twelve or fourteen days after child-birth, renders it highly probable that they are due to a clot in the pulmonary artery.

Prognosis.—This is to be looked upon as of the gravest character, if once symptoms arise which indicate the existence of a clot in the pulmonary vessels. The smallest plugs formed in branches which are being invaded by a progressive destructive change in the lungs, are protective in character, and prevent or diminish an hæmoptysis which erosion of the vessels might produce.

Treatment.—In the most rapid cases death takes place before anything can be done; but in the less severe cases two points have to be attended to, namely, absolute rest, and free stimulation by brandy, digitalis, ether, and ammonia, for by such means only can any hope be entertained of preventing an extension of the clot. Sinapisms over the cardiac region often afford relief, but opiates for the sleeplessness which is met with in some of the prolonged cases are very badly borne.

W. H. Allchin.

PULSATION (*pulso*, I beat).—Pulsation is a sensation of beating or throbbing, either objectively appreciated by inspection or palpation, or subjectively felt. It originates in the presence of a pulse or rhythmical rise and fall of blood-pressure, whether normal or abnormal, in connexion with the part where it is situated. In most instances this is either the heart or some large blood-vessel; but in other instances the pulsation has a different origin, especially when the phenomenon is abnormal. As instances of *normal* pulsation may be mentioned the cardiac impulse; the arterial pulse generally; the pulsation of the umbilical cord; and the beating of the fontanelles. *Abnormal* pulsation may be referable (1) to dilatation of a blood-vessel, as in aneurysm; (2) to vascular dilatation and cardiac enlargement, as in aortic incompetence; (3) to vascular dilatation and cardiac excitement, as in exophthalmic goitre; (4) to interference with the passage of blood through a vein, or even regurgitation into it, as in the jugular pulse of tricuspid disease; or (5) to the pressure of a tumour upon a large vessel, conveying the normal pulse unnaturally to the surface of the body, as in tumour of the pancreas or pylorus. Pulsation may also be present (6) in any part when it is the seat of inflammation, the small vessels being dilated; (7) in aneurysm by anastomosis; (8) in malignant disease of bone, which may closely simulate aneurysm; and (9) very rarely in connexion with empyema. *See* Pleura, Diseases of.

With respect to the characters of this phenomenon, it is of great practical importance to distinguish *true* expansile or eccentric pulsation from pulsation which is *communicated* only. In the former case the seat of pulsation expands rhythmically in all directions; in the latter case it is moved in one direction only, that is, it rises and falls under the influence of the motion conveyed to it.

The various pathological conditions which give rise to pulsation, and their treatment, are fully discussed under appropriate heads.

J. Mitchell Bruce.

PULSE, The.—Synon.: Fr. *le Pouls*; Ger. *der Puls*.—Each contraction of the heart, by throwing the contents of the left ventricle into the aorta, causes a sudden expansion of the systemic arteries, which is manifested by elongation and dilatation of these vessels. When the finger is placed upon an artery that runs on a resisting plane, such as the radius forms beneath the radial artery at the wrist, slight compression by the finger enables us to detect an increased hardness in the vessel at each cardiac contraction. It is this increase of hardness, or fulness, or, in other words, this change in the distension of the artery, which constitutes the pulse. In feeling the pulse the finger slightly compresses the artery, and thus flattens it; the cylindrical form is restored by each pulsation. The amount of pressure required to flatten the artery completely, is the rough-and-ready way of estimating its fulness or tension, and is best performed by compressing the vessel with the index finger, whilst the middle and ring fingers, placed more distant from the heart, check off the pressure required to stop the blood flow.

The movement of the artery perceived by the finger appears in most cases to be simple, but when registered by the sphygmograph it is found to be a compound of three waves, called the *summit wave*, the *tidal wave*, and the *dicrotism*. The *summit wave*, which caps the line of ascent of the trace, is due to the sudden oscillation in the blood-column, following immediately on the lifting of the aortic valves by the discharge of the contents of the left ventricle. The

tidal wave, or predicrotic, or *first secondary wave*, as it is also called, is due to the distension of the arteries, following the increased pressure in the aorta and great vessels, from the reception of the ventricular contents. The *dicrotism*, or *great secondary wave*, is an oscillation of the blood-column, mainly, if not wholly, produced by the rebound of the blood from the closed aortic valves under the pressure of the aortic recoil. *See* DICROTISM.

A pulse-trace (fig. 123) consists then in a *line of ascent*, *a* to *b*, which ends in the *summit wave*, *b*, and corresponds to the first part of the ventricular systole; from the

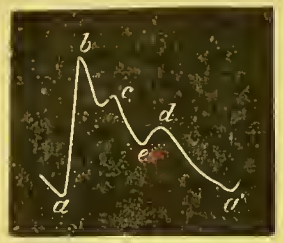

FIG. 123.—Typical Pulse-trace.—*a* to *b*, line of ascent; *b* to *a'*, line of descent; *b*, summit wave; *c*, tidal wave; *d*, dicrotic wave or dicrotism; *e*, aortic notch.

summit wave the tracing falls slightly, till it is again raised by the *tidal wave*, *c*. After the tidal wave a more marked descent occurs, called the *aortic notch*, *e*, and the line again rises, into the *dicrotic wave*, *d*. The *line of descent*, *b* to *a'*, is thus broken by two waves and two notches. The two waves have already been described; of the two notches one precedes the tidal wave, and indicates a slight collapse in the arterial wall after the oscillation called the summit wave; whilst the aortic notch, preceding the dicrotism, marks the fall of pressure in the arteries antecedent to the closure of the aortic valves. The moment these valves are closed the line of descent rises again. It is the bottom of this notch, marking as it does the closure of the aortic valves, which points out the termination of the ventricular systole. The remainder of the line of descent corresponds with the diastole of the ventricle, and is sometimes broken by smaller waves.

The pulse-trace is modified in its chief features by the state of arterial fulness or

FIG. 124.—Trace of Pulse of High Tension.

tension. When the tension is high (fig. 124) the line of ascent is less lofty; the tidal wave is large, nearer to, and sometimes blended with the summit wave; the aortic notch is shallow, and high in the line of descent; the dicrotism is not much developed; and the line of descent is gradual. When the tension is low (fig. 125), the line of ascent is lofty; the summit wave distinct; the tidal wave

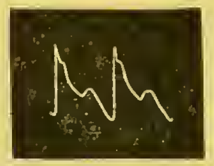

FIG. 125.—Trace of Pulse of Low Tension.

small; the aortic notch deep and low; the dicrotism highly developed; and the line of descent sudden. These modifications are interfered with if the normal elasticity of the arteries be lost, as in arterial degeneration.

The pulse thus registered by the sphygmograph, or felt by the finger, is an oscillation of the blood-column, primarily caused by the heart, but greatly modified by the properties of the blood-vessels. On the heart depend the rate, the rhythm, and, to some extent, the force of the pulse; whilst on the vessels depend the mode of the blood-flow, and the ease of its passage. By virtue of their elasticity, the larger arteries convert the intermittent, jerky impulse, given to the blood by the heart-beats, into an even flow of regular waves; and the smaller arteries regulate, by their permeability, the ease with which the blood-stream flows onward to the veins, thus governing to a great extent the fulness or tension of the arterial system.

The art of feeling the pulse consists in discovering, from the sensation imparted to the finger, the state of the arterial wall and the condition of the arterial contents, as manifested by the frequency, rhythm, and force or tension of the pulse-beat. When the artery is felt to be hard and cord-like, rolling more or less rigidly under the finger, changes in the arterial coats, due to degenerative arteritis or senile change, are indicated, which may render the vessel so rigid as to be practically incompressible. The radial artery is sometimes congenitally anomalous, and a high bifurcation of the vessel or other peculiarity may account for the absence or smallness of the pulse on one or both sides. The finger, as above mentioned, also estimates the fulness of the vessel from its compressibility, and hence learns how the heart and arteries are acting as regards the tension of the pulse. The effects of their action on the form of the pulse-wave the sphygmograph records. In children the pulse may often be most accurately observed in the temporal artery during sleep. *See* SPHYGMOGRAPH (which should be read with this article).

It will be convenient to consider in succession the *frequency*, the *rhythm*, and the *force* or *strength* of the pulse.

1. **Frequency.**—The frequency of the pulse depends on the rate of the heart's contractions. This rate varies with age, position, sex, stature, and a number of physical and psychical influences. In the newly born infant the heart and pulse beat some 130 to 140 times a minute. The rate gradually falls, and after the sixth year it is usually below 100; and a further decrease of 30 beats a minute gradually occurs before the rate of manhood (70 to 75 a minute) is reached. In old age the pulse-rate often rises again slightly.

In the erect posture the pulse beats at some 10 a minute in the male, and 7 in the female, over the rate of the sitting, and some 5 more over the rate of the recumbent position. The female of seven years has some 10 pulse-beats a minute more than the male of the same age. As regards stature, we may say briefly that height diminishes the number of beats slightly, a man of six feet having a pulse of 3 or 4 slower than a man of five and a half feet.

Movement and exertion of all kinds quicken the pulse, and mental emotion or excitement in neurotic persons runs up the rate very high. In examining healthy people for life assurance, as well as in visiting patients, this must be taken into account. A good meal increases the fulness and frequency of the pulse, and so does the use of stimulants in health, though in acute diseases the reduction of the pulse-rate may be often the test of their beneficial action. The pulse is less frequent during the night and during sleep; it rises in frequency during the early hours of the day, and falls to a minimum about midnight.

Increased frequency.—Such are the conditions which affect the pulse-rate ordinarily in healthy persons. In disease increased frequency is one of the most common changes, as, for example, the frequent pulse of all pyrexial attacks. The pulse-rate and the pulse-form, as recorded by the sphygmograph, are closely connected with the temperature-elevation. The pyrexial pulse-trace shows important modifications in the dicrotic wave, which become more and more developed as the pyrexia increases. The aortic notch deepens, and when it reaches the level of the curve-basis (the line joining the commencement of each line of ascent) the pulse is called *dicrotous* or *fully dicrotous*; this form corresponds with a pulse-rate of over 100 per minute, and a temperature of about 102° F. When the aortic notch sinks below the level of the curve-basis, and the dicrotic wave is blended with the line of ascent of the next pulsation, the pulse is called *hyperdicrotous*, and the temperature is generally about 104° F. (*see* fig. 130). A hyperdicrotous pulse, when accelerated, loses the dicrotic wave wholly, and becomes monocrotous. The pulse-rate in many febrile cases becomes a prognostic sign of great value, sometimes, as in puerperal cases, being of more value than the temperature.

Increased frequency is also present in debility, and in certain organic and functional affections of the vagus and sympathetic, for example, exophthalmic goître and the so-called hysterical cases of rapid pulse. In these latter there is generally a slight increase of temperature.

Diminished frequency.—A reduced pulse-rate is less commonly seen. It is usually associated with a condition of high tension from blood-impurity, as in renal disease. It is met with in jaundice, anæmia, and diabetes; in convalescence from pneumonia; in relapsing fever; in the earlier stages of typhoid; in fatty degeneration of the heart; and in some nervous affections, especially of the medulla. In one of these last cases the writer has observed a pulse of 24; and a rate as low as 14 a minute has been recorded.

2. **Rhythm.**—The rhythm of the pulse depends also on the rhythm of the heart; regular heart-action produces regular pulse, and *vice versâ*. Variations in rhythm are of two kinds, *intermittence* and *irregularity*.

Intermittence.—Intermittence means the omission of a beat from time to time. This omission may occur at regular intervals, for example, every fourth, tenth, or twentieth beat; or it may occur irregularly, so that every now and then a beat is missed. Intermissions are more rarely observed in the young than in the old, and may be associated with no other evidence of disease. The intermissions usually disappear during pyrexial attacks. In some cases nervous excitement or fatigue will produce them; in others they depend on hypochondriasis, dyspepsia, the excessive use of tobacco, gout, over-work, and on heart failure from degeneration or some neurosis of the heart. Effort, such as briskly walking across the room, or holding both arms above the head, will increase the intermissions or irregularity in cases of organic cardiac weakness, but have little effect in neurotic cases. Occasionally an intermittent pulse is the first indication of deep-seated malignant disease. Some patients are unconscious of the intermissions, while others feel the heart stumble in its work, as it were, at each lost beat. In many persons intermissions are habitual, and do not necessarily indicate disease, but they do impair the life-value. Intermittent action is often observed in old persons otherwise healthy.

Irregularity. — Irregularity, the other variety of disordered rhythm, presents itself in two forms, as irregularity in frequency,

and irregularity in force. These two forms are frequently associated; of a number of pulsations no two may seem equal in force, and no two may succeed each other at equal intervals of time. In other cases a number of good, steady beats, regular in frequency and equal in force, may be followed by a disorderly series, unequal and irregular. These abnormalities are best observed in cases of mitral valve disease and in dilatation of the heart, although the pulse may be unequal and irregular in all forms of heart-disease at some period of their evolution. Mitral insufficiency affords the common examples of unequal and irregular pulse, though in this affection the pulse-beats may only be slightly unequal in size and form, but perfectly regular in the periodicity of their occurrence. In mitral stenosis irregularity and intermissions are generally associated with inequality. Some intermissions are what are commonly called *false* intermissions, the ventricular systole being too weak, or the wave of blood thrown into the aorta too scanty, to be perceived at the wrist. In such cases the sphygmograph records the wave which escapes the finger. In mitral cases irregularity and inequality are increased by exercise. *See* SPHYGMOGRAPH.

Inequality in the size of the pulsations often depends on respiratory influences. The curve-basis, or respiratory line as it is sometimes called, falls with full inspiration and rises with expiration. With low tension these variations are increased, with high tension they are scarcely apparent. In severe dyspnœa the curve-basis becomes undulatory. Thus deep inspiration, which normally reduces arterial tension, lessens the size of the pulsations, and quickens the pulse; while expiration raises the tension, increases the size of the pulsations, and slows the pulse. An exaggeration of these effects constitutes the *pulsus paradoxus* or *pulsus inspiratione intermittens*, first observed in indurative mediastino-pericarditis, but not limited to that condition. In some cerebral cases, and also in mitral affections, the regular succession of a large and a small pulsation is observed, constituting the *pulsus alternans*; when the pulsations go in pairs it is called *pulsus bigeminus*; when a series of three occurs, *trigeminus*.

In health the pulse may sometimes be noticed to be irregular on waking; and in convalescence from acute disease irregularity in force and time is not infrequent. Irregularity sometimes depends on reflex disorder from gastro-intestinal causes; tea and tobacco taken in excess are common causes of irregularity and palpitation.

The pulse may be occasionally *suppressed* in one or all the arteries. When general, this is due to cardiac weakness, and the sphygmograph will often record a small gradual pulse-wave, which escapes the finger. When partial, the suppression is due to either compression, thrombosis, or aneurysm of a main vessel.

The pulse in one radial occasionally is felt to occur later than in the other artery; this is called *retardation*, and usually indicates aneurysm.

3. **Force.**—The force of the pulse, which the finger estimates by the amount of pressure required to obliterate it, and which the sphygmograph measures by the weight or pressure required to develop to the full the main features of each pulsation in the trace, is the product, in the first place, of the heart's vigour. The distribution of the heart's force, however, depends on the peripheral resistance of the smaller blood-vessels. When these are relaxed and open, a vigorous heart has its force distributed quickly over the whole vascular area by the rapid onward passage of the blood. When, on the contrary, the arterioles are contracted, the heart's force is retained in the arteries for a longer time. In the first case, the pulse is soft and compressible, from the small quantity of blood retained in the artery; in the second case, it is hard and relatively incompressible, from the fulness of the artery with blood under high pressure. It may be well to point out here, that the size of the pulse and the amplitude of the pulse-trace are by no means precise indications of its force or strength. These qualities depend on the sudden variations in tension (fulness of blood) which the artery undergoes. For instance, a moderately strong ventricle will produce in states of easy blood-flow through the capillaries an ample pulse, but one easily compressed; whilst the same ventricle, acting with even more force, in conditions of lessened capillary permeability, will produce a pulse much less ample, lasting longer under the finger (*pulsus tardus*), and less easily compressed. The simple experiment of feeling, or recording with the sphygmograph, the pulse when the capillaries are dilated by a warm foot-bath, and, again, when contracted by a cold one, will exemplify this. The permeability of the smaller vessels also reacts on the heart, and influences both the frequency and mode of contraction. When the capillary circulation is easy, the heart's action is more frequent, and the ventricular contractions shorter or more sudden; when, on the contrary, the circulation is obstructed by contraction of the peripheral vessels, the heart's action becomes less frequent, and the ventricular contraction is longer and less sudden. Thus the vascular tension may be said to be in inverse proportion to the frequency and suddenness of the heart's action. The force of the pulse, as thus modified by the state of the peripheral circulation, gives us some of our most important clinical information.

Modern clinical research shows how valuable is a study of this force of the circulation, as manifested by the tension of the arteries. It is this quality of tension which forms the best basis for the division of the various pulse-forms into the two great classes of *hard* and *soft* pulses, or pulses of high and low tension. The hard pulse requires considerable pressure to enable the sphygmograph to record its features to the full; the soft pulse yields the best trace to slight pressure.

Miscellaneous Characters.—The *size* of the pulse depends on the development of the line of ascent and the tidal wave, which are modified by the volume of blood expelled by the ventricle, and the state of fulness of the arteries. When the arteries are contracted, the pulse is small, hard, and wiry; when the coats are relaxed, it is large and soft. The *flickering* pulse is indicative of feeble and unequal ventricular contractions; and the *undulatory* character noticed in some weak pulses is due to the influence of the respiratory movements, causing variations in the tension. The quality of *suddenness* (quick ventricular systole) is betrayed by a nearly vertical line of ascent; while the *gradual* pulse (slow ventricular systole) has an oblique up-stroke.

The following arrangement shows in a small compass the principal varieties of pulse met with in practice, apart from the quality of regularity.

A. **Varieties of Hard Pulse—Pulsus durus.**

1. The *hard, frequent, sudden*, and *small pulse* of peritonitis, enteritis, and pericarditis :—

Pulsus durus et frequens et celer et parvus, fig. 126.

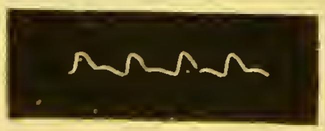

Fig. 126.

2. The *hard, slow, gradual*, and *large pulse* of contracted kidney :—

Pulsus durus et rarus et tardus et magnus, fig. 127.

Fig. 127.

3. The *hard, large*, often *gradual pulse* of cardiac hypertrophy and degeneration of blood-vessels :—

Pulsus durus et magnus et tardus, fig. 128.

Fig. 128.

4. The *hard, sudden (jerky), large*, and *vibratory pulse* of aortic insufficiency, with strong ventricle :—

Pulsus durus et celer et magnus et vibrans, fig. 129.

Fig. 129.

B. **Varieties of Soft Pulse—Pulsus mollis.**

1. The *soft, frequent pulse* of pyrexia; dicrotous, fully dicrotous, and hyperdicrotous pulses :—

Pulsus mollis et frequens, fig. 130.

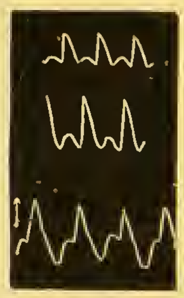

Fig. 130.

2. The *soft, frequent*, and *large pulse* of rheumatic fever :—

Pulsus mollis et frequens et magnus, fig. 131.

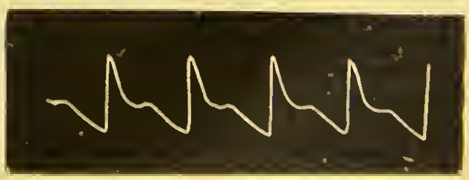

Fig. 131.

3. The *soft, small, frequent*, and *sudden pulse* of debility :—

Pulsus mollis et frequens et parvus et celer, fig. 132.

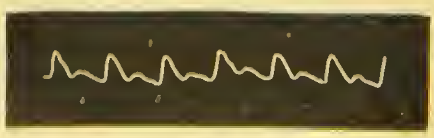

Fig. 132.

4. The *soft*, *frequent*, and *small* (*running*) *pulse* of collapse in fever:—

Pulsus mollis et frequens et parvus, fig. 133.

Fig. 133.

B. Walter Foster.

PUPIL, Disorders of the.—Synon.: Fr. *Troubles de la Pupille*; Ger. *Stöhrungen der Pupille.*

Anatomy and Physiology.—The pupil is the approximately circular aperture situate a little to the nasal side of the centre of the iris. Responsive to the various influences which cause contraction and relaxation of the muscular and elastic tissues and blood-vessels of the iris, the pupil serves to regulate the amount of light entering the eye, and to correct some of the spherical aberration of the refracting media. In health, and when the lids are open, both pupils undergo frequent and equal variations in size: *contracting* when a bright light falls upon the eyes, and when the eyes converge or are accommodated for near objects; *dilating* when the light is feeble or the eyes are shaded, and when the accommodation is relaxed and the eyes are directed to some distant object. They also dilate when the skin is pinched, or when the cutaneous or other sensory nerves are stimulated, and in some psychical and emotional states. Fine oscillations occur synchronously with the beatings of the heart, and others with the movements of respiration. Variations in the size take place in many other physiological states. During muscular exertion, and as the result of fatigue, the pupils dilate; in deep sleep they contract. The pupils of both eyes contract and dilate together, even when only one eye is stimulated. The movements of the iris are involuntary, but, being coördinated with changes of accommodation, they are brought indirectly under the influence of the will.

The *size* of the pupils differs in different individuals, and in the same individual at different periods of life, and in different states of health and nutrition. The pupils are very small in newly born babes, larger in children and young adults, and smaller again in old persons. They are generally larger in myopic eyes, and in persons with dark irides; smaller in hypermetropes, and in persons with fair or blue irides. The size may range in health from 2·5 mm. to 6 mm.

A closer examination of the variations in the size of the pupil, and of the circumstances under which they take place, shows that some of the movements of the iris are 'reflex,' some are 'associated,' and some are 'consensual.' The contraction to the direct stimulation of light is reflex, as is also the dilatation which occurs on stimulation of the cutaneous nerves. The contraction which takes place during convergence or accommodation is associated; while the harmonious and equal action of both pupils when only one eye is stimulated is consensual.

The contracting mechanism of the iris is innervated by the third cranial nerve; the dilating mechanism by the cervical sympathetic. At the pupillary margin of the iris is a ring of plain muscular tissue (sphincter iridis); and in the expanse of the iris, and lying between the vascular and the posterior pigment layers, is a thin elastic lamina composed of long oval or rod-shaped nuclei, and radially disposed. Some authorities regard this lamina as muscular (dilator iridis), whilst others deny its muscular character. Constriction of the pupil is produced chiefly by the contraction of the sphincter muscle, though it is augmented by the turgescence of the blood-vessels of the iris. The dilatation of the pupil is perhaps less simple. It may be due to contraction of the dilator muscle. Those who deny the existence of this muscle ascribe the dilatation to the inhibitory influence exerted by the sympathetic nerves upon the sphincter muscle. According to this view, dilatation is a complex act due partly to relaxation of the sphincter, partly to the elasticity and resiliency of the iris, and partly to the depletion of its blood-vessels.

The *contraction* which takes place when light falls upon the eye is a reflex act, of which the optic nerve is the afferent path; while the efferent path is that portion of the third cranial nerve which passes through the lenticular ganglion, and enters the eye with the *short* ciliary nerves. The 'centre' is the anterior portion of the elongated nucleus of the third nerve, which lies in the front part of the floor of the aqueduct of Sylvius. From the anterior extremity of this nucleus arise also the motor fibres which govern the muscle of accommodation; and the community, or at least contiguity, of these two centres helps to explain the 'association' of contraction of the pupil with accommodation. It is, however, still uncertain how the afferent fibres reach the constrictor centre; but it would seem that these fibres are not the same as those which subserve vision, and that indeed they leave the optic path either at the chiasm, or at some other part of the tract before the visual centres are reached. The 'consensual' reaction of the pupil is accounted for partly by the incomplete decussation of the optic nerve at the chiasm, and partly by the communication (coupling) between the centres of the third nerves of the two sides, whereby the constrictor apparatus of the two eyes become functionally connected.

The *dilating mechanism* is governed by

the cervical sympathetic nerve. If this nerve be divided, the pupil contracts; and if the peripheral end be stimulated, the pupil dilates. The dilator path may be traced backwards down the neck to the upper thoracic ganglion, and along the ramus communicans to the anterior root of the second thoracic nerve, and then to the spinal cord (Foster); thence up the cord and through the bulb to a centre in the floor of the aqueduct of Sylvius, near, and a little to the outer side of, the pupil constrictor centre. Towards the eye the path is traceable, *not*, as formerly believed, to the sympathetic root of the lenticular ganglion, but to the fibres which, passing over the Gasserian ganglion, apply themselves to the ophthalmic division of the fifth nerve, and thence proceed to the nasal branch, finally reaching the eye with the *long* ciliary nerves. The existence of a dilator centre in the lower cervical and upper dorsal region of the cord (*centrum cilio-spinale inferius*) is now considered doubtful (Foster). The dilator centres are in some way connected with the afferent nerves of the body generally, so that, as already stated, the pupil dilates when the skin is irritated by pricking or tickling or in any other way. This centre is also stimulated by dyspnœic blood, and by loud noises, by severe pains, &c.

The fifth nerve plays a subsidiary part in the movements of the pupil. It acts probably only as a sensory nerve, and it is doubtful whether it has any fibres which directly influence the movements of the iris. Irritation and injuries of the cornea do, however, cause contraction of the pupil. This is apparently a reflex impulse, the path of which has not been clearly ascertained. This reflex is said not to be abolished by the separation of the oculo-motor nerve from its central nucleus. It has been further alleged that direct stimulation of the margin of the cornea causes dilatation of the pupil, and stimulation of the centre of the cornea, contraction (E. H. Weber).

Physical Examination.—The *size* of the pupil may be conveniently measured by means of a gauge, consisting of a series of dots or apertures ranging in size from 0·5 mm. to 7 or 8 mm. The *reactions* of the pupil should be tested in a good diffused light, preferably daylight. Each eye should be examined separately, and in testing the reflex reactions the patient's gaze should be fixed upon a distant object, in order that the consensual and the associated actions may be in abeyance. The eye which is not under examination having been completely covered, the size and shape of the pupil under observation should be first noted, and then the eyelids closed or covered by the hand (or other opaque body) for a few seconds. In health the pupil quickly dilates. When the eye is exposed, the pupil readily contracts. After a brief interval it dilates again a little, and again contracts; until at length it becomes stationary. Note should be made of the degree, promptness, and vigour of these movements, and of their equality or inequality in the two eyes. Next, the 'associated' movements with accommodation and convergence should be investigated; and lastly the 'consensual' movements. Even in disease, so long as there is quantitative perception of light, there is, as a rule, pupillary reaction. Sometimes, however, reflex reaction is maintained in an eye which is totally blind, and less rarely it is lost while there is still more or less sight. 'Associated' movements may be also maintained after the reflex reactions have been abolished (as in locomotor ataxy), and 'consensual' reaction may persist after direct reaction has ceased. The presence or absence of reflex contraction on stimulation of a blind eye depends upon the seat of the lesion. If the lesion be above the corpora quadrigemina, pupillary reflex may persist without quantitative perception of light. In testing these various movements, care should be taken to appreciate the modifications due to local disorders within the eye. The movements of the iris may be hampered, or altogether prevented, by the presence of adhesions between the iris and the capsule of the lens (posterior synechia), or adhesions to the cornea (anterior synechia); by the remains of the embryonic capsulo-pupillary membrane; by excess or deficiency of the aqueous humour; by undue hardness or undue softness of the eyeball; by absence or dislocation of the crystalline lens; by atrophy of the iris from any cause whatever; or by the action of certain medicaments applied to the eye or internally administered, such as belladonna, Calabar bean, or opium.

Pathology.—Disorders of the pupil manifest themselves by alterations in its shape, size, mobility, and reflexes. Those alterations which arise from local changes in the iris or other parts of the eye need not be considered here. Many alterations in the pupil occur symptomatically in some general diseases, and especially in diseases of the nervous system. In such cases alterations in size are usually associated with alterations in mobility and reflexes. Rarely, there is entire absence of reaction to all kinds of stimuli with a pupil of ordinary size, as in cases where there is paralysis of both the contracting and the dilating mechanisms. It is difficult, perhaps not possible, in the present state of knowledge to give a classification of disorders of the pupil at once simple and comprehensive. It cannot always be determined whether an alteration is due to spasm of one mechanism or paralysis of its antagonist. In some diseases there is sometimes alteration in the pupil, and sometimes none; and, even when present, the

alteration is not always of the same kind, and may differ at different stages of the same disease. In some general diseases there are alterations without any appreciable disease either of the eye or of the nervous system. The pupil presents characteristic differences in typhus and typhoid fevers. In typhoid the pupils are dilated; in typhus they vary from medium dilatation to extreme contraction. In intrathoracic tumour, and other diseases pressing upon the sympathetic nerves, there may be dilatation of one or both pupils in the early stages from irritation, and contraction in the later stages from destruction and paralysis of the sympathetic. The state of the pupil is not always constant in diseases which more directly implicate the nervous system. In migraine the pupil is in some cases dilated on the affected side (Du Bois-Reymond), in some contracted (Piorry); in some both pupils are equally contracted (Möllendorff), and in some the pupils are normal (Liveing). In apoplexy the state of the pupils is variable, though usually they are dilated, or one is larger than the other; in hæmorrhage into the pons the pupils are contracted, though whether from irritation of the constrictor mechanism, or from paralysis of the dilator, is not always clear. In apoplectic convulsive seizures the pupils are often widely dilated; in softening of the brain, sometimes dilated, sometimes contracted. In sunstroke they are contracted. In disease of the spinal cord the alterations of the pupil vary with the stage of the disease. There may be dilatation from irritative lesions, or contraction from a paralysing lesion; and the pupils are often unequal. In degeneration of the cord there is often double myosis, associated with loss of light-reflex, and loss of reflex dilatation from stimulation of the cutaneous nerves.

For clinical purposes disorders of the pupil may be classified as (1) contraction (myosis); (2) dilatation (mydriasis); (3) clonic spasm of the sphincter (hippus); (4) paralysis of the constrictor and of the dilator mechanisms (iridoplegia); (5) disorders of the constrictor reflex; (6) disorders of the dilator reflex; and (7) disorders of associated action.

1. **Myosis** (μύω, I close).—SYNON.: Called by some, but not very appropriately, *Miosis*, from μείωσις, which signifies diminution in *bulk*, and is already employed as a technical term in rhetoric.—Myosis is an unnatural smallness of the pupil, and may be mechanical, toxic, or neuropathic. The mechanical forms are due to some ocular disease, or to excessive use of the accommodation at near objects.

As a neuropathic state, myosis may be due to spasm of the pupil-constrictor mechanism (*spasmodic myosis*); paralysis of the dilator mechanism (*paralytic myosis*); or a combination of the spasmodic and paralytic forms. In the two first named, there is medium contraction of the pupil, which still retains some mobility. In the last, the contraction is extreme, and the pupil is immobile.

(*a*) *Spasmodic myosis* occurs whenever there is direct or indirect irritation of any part of the reflex apparatus of the pupil-constrictor system. In a high degree the pupil does not further contract to light or to accommodation. It does not dilate on shading the eyes, and there is but slight dilatation by sensory or emotional stimuli; mydriatics act moderately and myotics excessively. It may occur reflexly from injury or disease of the cornea, iris, and ciliary body; and from some diseases of the optic nerve, retina, and choroid. More directly it may occur in the early stages of a new-growth at the base of the brain, of basal meningitis, or of any morbid change in the third nerve itself. In such cases there is often convergent strabismus. It is an almost invariable symptom of the early stages of meningitis of the convexity. In the later stages of meningitis mydriasis may occur. It occurs also in meningeal apoplexy, and hæmatoma of the dura mater. Spasmodic myosis, followed by dilatation of the pupil, has been pointed out as diagnostic between apoplexy and embolism, inasmuch as in the latter condition change of the pupil does not take place (Berthold). At the onset of an epileptic seizure there is often a momentary contraction followed by dilatation. Spasmodic myosis is said to occur in the early stages of tobacco amblyopia. Nicotine internally administered produces it, probably from the stimulation of the pupil-contracting centres. Opium probably acts similarly. Some poisons produce different effects at different stages of their action. Chloroform, ether, and alcohol at first dilate the pupils; then contraction takes place; and if the effect of the poison be prolonged or increased, dilatation may occur again. This is always an indication of great danger. Certain medicaments, such as Calabar bean and its alkaloid physostigmine, and muscarine, also cause myosis through stimulating the sphincter, and perhaps also paralysing the dilator mechanism.

(*b*) In *paralytic myosis* there is medium contraction, and the pupil contracts to light, accommodation, and convergence; it dilates moderately to mydriatics, and contracts fully to myotics; and there is no dilatation to sensory irritation or to emotional stimuli. It may be due to a paralysing lesion of the dilator centre, disease of the pons, or any part of the course of the fibres passing from the centre to the eye. It occurs, also, in injuries and other affections of the 'ciliospinal region' of the cord, as rupture of the root of the brachial plexus, paralysis of the cervical sympathetic from wounds or from

destructive compression by tumours, enlarged glands, or aneurysms of the carotid or innominate or aorta. It occurs in locomotor ataxy, and in other diseases due to degeneration of the posterior columns of the spinal cord (spinal myosis), in cortical disease of the frontal lobes, in the later stages of acute mania, in the pauses of Cheyne-Stokes respiration, in the algide stage of cholera, and in alcoholic amblyopia.

In the more advanced stages of locomotor ataxy a form of myosis is often met with, in which the light reflex is lost, but contraction to accommodation and convergence is retained (Argyll-Robertson pupil). This condition is probably due to a double lesion, implicating, on the one hand, the pupil-dilator centre or the fibres which pass from it to the eye, and, on the other, some portion of the afferent path of the pupil-constrictor apparatus between the retina and the nucleus of the third nerve in the floor of the aqueduct.

(*c*) In *combined spasmodic and paralytic myosis* there is extreme contraction; with immobility to light, accommodation, and sensory stimuli; mydriatics produce but slight dilatation, while myotics have no appreciable effect. The condition is rare, and is more common as a complication of the paralytic than of the spasmodic form of myosis. It may occur when a spasmodic myosis from efforts of accommodation and convergence is superadded to a long-standing paralytic myosis; or when meningitis of the convexity of the brain complicates a paralytic myosis. (Ross.)

2. **Mydriasis.**—Mydriasis is an unnatural dilatation of the pupil. It may, like myosis, be mechanical, toxic, or neuropathic. The mechanical form is due to local conditions, such as glaucoma, intra-ocular tumour, &c., and need not be further considered here. Neuropathic mydriasis may be due to spasm of the dilator mechanism (*spasmodic mydriasis*), to paralysis of the constrictor mechanism (*paralytic mydriasis*); or to a combination of the spasmodic and paralytic forms. In the two former there is medium, not full, dilatation, and the pupil is mobile to some stimuli. In the last there is extreme dilatation and immobility to all stimuli.

(*a*) In *spasmodic mydriasis* there is medium dilatation; the pupil contracts slightly to light and accommodation; it does not dilate to sensory or emotional stimuli; it is difficult to contract by myotics, easy to suffer maximum dilatation by mydriatics. Spasmodic mydriasis occurs whenever there is irritation of the dilator centre or of the nerve-fibres going to the eye, as in the early stages of tabes dorsalis, in myelitis and meningitis, and other irritative lesions of the cervical spinal cord: irritative lesions in the neck, such as injuries, enlarged glands, tumours, or aneurysm, exciting the cervical sympathetic. Spasmodic mydriasis occurs in the early stages of many affections which later end in paralytic myosis. It also occurs in severe neuralgia, affecting any of the nerves of the body except the ophthalmic division of the fifth nerve, in which myosis is more common; in renal and biliary colic, gastralgia, the irritation produced by intestinal worms, in 'spinal irritation,' anæmia of the brain, with or without general anæmia, in dyspnœa, Cheyne-Stokes respiration, after a paroxysm of whooping-cough, during the spasm of tetanus, epilepsy, eclampsia, acute mania, melancholia, increased intracranial pressure, chronic hydrocephalus and tumours of the brain. In general paralysis of the insane there is often unequal dilatation; and quickly alternating mydriasis and myosis has been observed as a precursor of grave mental states. (Von Graefe.)

The dilatation which occurs when belladonna, atropine, or similar drugs are applied to the eye is probably due to a paralysis of the sphincter, with also stimulation of the dilator mechanism. The dilatation which takes place with cocaine is probably only the effect of the changes which this drug produces in the size of the blood-vessels.

(*b*) *Paralytic mydriasis* is due to paralysis of the constrictor mechanism. There is moderate dilatation, with reaction to sensory and emotional stimuli. The pupil dilates well to mydriatics, and contracts but slightly to myotics. The reactions to light and to accommodation vary with the seat of the lesion. If the lesion be in any part of the afferent optic path, there is no light reflex, but the pupil contracts on convergence and accommodation, and consensual reaction is retained. If the lesion be in the centre or along the efferent path (third nerve) there is no reaction to direct or consensual stimulation, or to accommodation and convergence. If the lesion be in the fibres which connect the optic nerve with the nucleus of the third nerve, the pupil will not contract to light, though there may be sight, but it will contract on convergence. In cases of blindness due to lesion in the visual centres above the corpora quadrigemina pupillary reaction may be normal. Paralytic mydriasis may occur in diseases of the base of the brain affecting the constrictor centre; in disease of the third nerve, in the later stages of meningitis, in thrombosis of the cavernous sinus and in progressive paralysis of the insane. It also occurs in the later stages of diseases in which there was an earlier myosis. It may also be associated with atrophy of the optic nerve.

(*c*) In *combined spasmodic and paralytic mydriasis* there is complete immobility to all stimuli except strong myotics, which lessen the dilatation somewhat. This condition is rare, but it may occur when irritation of the dilator mechanism is superadded to a

pre-existing paralytic mydriasis, or when a destructive lesion of some part of the constrictor mechanism is superadded to previous spasmodic mydriasis; the latter condition is occasionally seen in general paralysis of the insane. In long-standing paralytic mydriasis the dilating tissues of the iris may undergo secondary contraction. (Ross.)

3. **Hippus.**—SYNON.: Chorea of the iris. Hippus consists of quickly alternating contractions and dilatations of the pupil, probably due to clonic spasm of the sphincter. It is sometimes accompanied by nystagmus, and is occasionally seen in the regressive period of paralysis of the third nerve. It occurs also in multiple sclerosis, acute meningitis, and some apoplectic attacks.

4. **Paralysis of the Constrictor and the Dilator Mechanisms.**—In this morbid condition the pupil may be of medium size, or contracted, or dilated. The paralysis may be confined to the iris (*iridoplegia*), or the ciliary muscle may also be involved (*ophthalmoplegia interna*). There is no response to light or accommodation, and only slight effect from either mydriatic or myotic drugs.

5 and 6. **Disorders of Pupillary Reflexes.**—Disorders of the pupillary reflexes may be (*a*) disorders of the *constrictor* reflex; (*b*) disorders of the *dilator* reflex.

(*a*) *Disorders of the constrictor reflex.*—(1) In *lesions in the optic afferent limb* the pupil is dilated, and the sphincter loses its tone. There is no light reflex, but the pupil does contract to convergence and accommodation. In unilateral blindness, due to atrophy of the optic nerve, neither pupil may contract if only the retina of the blind eye be stimulated, but both pupils will contract if the sound eye be stimulated (*consensual reaction*).

(2) *Lesions of the efferent limb* may exist, either at the constrictor nucleus or in any part of the course of the third nerve. It is usually associated with paralytic mydriasis, to which the reader is referred.

(*b*) *Disorders of the dilator reflex.*—The *afferent* fibres in this reflex are those which connect the dilator centre with the skin and the periphery of the body generally; while the *efferent* fibres are those which pass from the dilator centre down the cervical spinal cord to the cervical sympathetic, and thence to the eye by way of the *long* ciliary nerves.

The skin and sensory reflexes are lost in some diseases of the cervical sympathetic, and of the cervical spinal cord. They are often lost in general paralysis, in locomotor ataxy, and other degenerative diseases of the cord.

7. **Loss of Associated Action** (Gowers). The pupil does not contract on efforts of accommodation. Indeed, there may be also paralysis of accommodation (*cycloplegia*). It may be due to disease in the nucleus of the third nerve or along any part of its course, or to disease of the lenticular ganglion. This condition may be a sequel of diphtheria (diphtheritic paralysis). It occurs also in degenerative diseases of the cord.

J. TWEEDY.

PURGATIVES.—SYNON.: Fr. *Medicaments Purgatifs*; Ger. *Abführungsmittel.*

DEFINITION.—Substances which cause intestinal evacuations.

ENUMERATION. — Purgatives are divided into several classes, namely, *drastic*, *simple*, *saline*, *hydragogue*, *cholagogue*, and *laxative*. Under the *drastic* purgatives may be classed Colocynth, Croton oil, Gamboge, Jalap, Podophyllin, Scammony, and Elaterin. Amongst the *simple* purgatives are Aloes, Castor oil, the juice of various species of Rhamnus (*e.g.* Buckthorn, Cascara sagrada, and Frangula), Rhubarb, and Senna. Under the head *saline* we have neutral salts, especially the Sulphates of Magnesium, Potassium, and Sodium; Citrate and Tartrate of Potassium; Bitartrate of Potassium, Tartarated Soda, and Phosphate of Sodium. *Hydragogues* include Bitartrate of Potassium, Elaterin, and Gamboge. *Cholagogues* comprise Aloes; Mercurial preparations, such as Calomel, Blue pill, and Grey powder; Podophyllin, Iridin, Euonymin, and other substances of the same class. The *laxatives* are small doses of simple purgatives, such as Carbonate of Magnesium, Magnesia, Olive oil, and Sulphur, as well as such vegetable substances as contain salines and sugar in considerable proportions, namely, Cassia, Figs, Honey, Manna, Prunes, Tamarinds, and Treacle.

ACTION.—The increased intestinal evacuation produced by purgatives is partly due to acceleration of the peristaltic movements of the intestine, so that the intestinal contents are hurried along more quickly, and less time is allowed for their absorption. Many authorities, especially in Germany, have held this to be the only way in which purgatives act; but there is no doubt that many of them also produce increased secretion from the intestinal glands. The different classes of purgatives affect the intestinal movements and intestinal secretion in different degrees. *Laxatives* and *simple purgatives* act chiefly, if not entirely, by increasing the peristaltic action. Some of the *drastic* purgatives act in both ways; whilst the *hydragogue cathartics*, as well as the *salines*, especially increase the intestinal secretion. In the case of some of the salines, as acid tartrate of potassium, the secretion is greatly increased, while the peristaltic movement is so little affected that the secretion may lie so long in the intestine as to be again reabsorbed, and the drug therefore fails to produce purgation at all. For this reason it is usual to combine such salines with simple purgatives, which will accelerate the peristalsis, as acid

tartrate of potassium with jalap, and sulphate of magnesium with senna.

Besides their direct action upon the bowels, purgatives exert an indirect effect upon the circulation, weakening it, and lowering the pressure of blood within the vessels.

Cholagogue purgatives are those which have a special power to remove bile from the body. They may do this either by stimulating the secretion of the liver, or by quickening the expulsion of bile from the gall-bladder and ducts, so that more bile is poured into the intestine at a time when this is in active movement. The bile is therefore hurried down the intestinal tube, and reabsorption is thus prevented. This appears to be the mode of action of such purgatives as euonymin and iridin. Such mercurial preparations as blue pill and calomel appear to act in a somewhat different way. Experiments, contrary to expectation, have shown that they do not increase the secretion of bile, and yet they are amongst the most efficient cholagogue purgatives which we possess. Their cholagogue action is probably due to their exerting a special stimulating action upon the duodenum, quickening its peristaltic movements, and thus hurrying down the bile, and preventing its reabsorption. Their beneficial action as cholagogues is greatly increased by the subsequent administration of a saline purgative, which will tend to sweep the bile out of the lower part of the small and the large intestine, and prevent reabsorption from these.

Uses.—Purgatives are used, firstly, to remove fæcal matters from the intestinal tube. They thus not only prevent the accumulation of such matters, but remove the irritation which their presence produces, and which may evidence itself in disturbances of other organs, for example, headache and malaise. These disagreeable symptoms produced by constipation appear to be partly due to the irritation of the intestinal nerves, producing reflex disturbance of the circulation; but it is probable also that they may be caused in part by the toxic action of poisonous gases, liquids, or solids generated in the intestine by imperfect digestion or decomposition of the food. For such purposes as this we may employ, as we find them necessary, laxatives or simple purgatives. The second use of purgatives is to remove from the body an excess of certain secretions such as bile, and substances which may be contained in them, such as metallic or organic poisons which are excreted in the bile or intestinal mucus. The third use is to remove liquid from the body in cases of dropsy, due either to cardiac or to renal disease. For such purposes we use hydragogue cathartics. The fourth use is to lower the temperature in fever, and for this we chiefly use salines. The *modus operandi* here is not yet well understood. The fifth use of purgatives is to lower the blood-pressure, and thus to prevent the rupture of a blood-vessel, and consequent apoplexy; or to prevent further extravasation in a case where the vessel has already burst, as in hæmorrhage from the lungs.

T. Lauder Brunton.

PURGING.—A popular synonym for diarrhœa; and also applied to the therapeutical method purgation. *See* Diarrhœa; and Purgatives.

PURPURA.—Synon.: Cutaneous Hæmorrhages; Fr. *Purpura*; Ger. *Blutfleckenkrankheit.*

Definition.—A diseased condition in which circumscribed effusions of blood take place into the upper layers of the cutis, and beneath the epidermis; occurring without or with certain constitutional symptoms, or in the course of various diseases; and attended at times by hæmorrhages under and from the mucous membranes, as well as into the various serous cavities.

Ætiology.—Cutaneous hæmorrhages have been seen as early as the third day after birth, and indifferently at all other periods of life. Women appear to be more frequently attacked than men.

Cutaneous hæmorrhages, when not due to external injury, may occur in persons apparently in the most perfect health, or they may accompany the most various diseases of the general system. They are common in the specific fevers, especially typhus, variola hæmorrhagica, epidemic cerebro-spinal meningitis, scurvy, snake-bite, and hæmophilia. They are not infrequent in the course of Bright's disease, and valvular disease of the heart; they have been seen in phthisis, acute rheumatism, cirrhosis of the liver, leucocythæmia, intermittent fever, and, in fact, in patients of the most different constitution and general condition, from perfect health to the most advanced cachexia. The exciting cause is usually quite obscure, but purpura has been seen to follow severe fright, and also sudden obstruction of the circulation, as in severe coughing and epilepsy, though this is exceptional. Purpuric eruptions have followed the use of chloral hydrate in excessive doses, iodide of potassium in specially susceptible individuals, and the inhalation of chloroform. They may be due to want of support of the vessels in old age, or under diminished atmospheric pressure.

Anatomical Characters.—The rete mucosum and the papillary layer of the cutis are the chief seats of the hæmorrhage in purpura. Owing probably to rupture of the capillaries over a limited area, the blood finds its way into the meshes of the connective tissue, and fills the interspaces between the hair-follicles and the ducts which traverse these parts. Absorption of the serum is soon followed by changes in the hæmatin set free from the red corpuscles, so that it passes through various

tints of blue, green, and yellow, until it is completely absorbed. Very large extravasations may result in long-continued or even permanent pigmentation of the part, owing to the formation of hæmatoidin. Similar effusions to those beneath the skin are found in the severer cases beneath the mucous membranes also; but in these parts bleeding from their free surface is not uncommon, probably from the delicacy and slight resistance of the membrane covering the capillaries. *Post-mortem* examination in fatal cases has revealed extensive extravasation into the pleural, pericardial, peritoneal, and, very rarely, into the arachnoid cavities. Extravasation may also occur into the muscles, the periosteum, and even the bones, as well as beneath the conjunctiva and into the retina. Cases complicated with other diseases, such as phthisis or Bright's disease, will present their characteristic lesions.

Pathology.—Purpura appears to depend (1) on an alteration in the nutrition of the coats of the blood-vessels, which makes them unequal to the strain of arterial pressure, so that they rupture; or (2) on alterations in the blood itself (excess of water, or salts); or (3) on both causes combined. That weakness of the vessel-walls is a main cause, is shown by the greater frequency and extent of the purpuric eruption on the feet and legs, and on the most dependent parts, such as the back, if the patient be recumbent, where gravity intensifies arterial pressure. The influence of the nervous system may account for some cases of rapid hæmorrhage, for this condition has been experimentally produced in frogs by extirpation of the sympathetic ganglia.

Embolism and thrombosis have been suggested as an explanation of some cases. The relation of the joint-affections which so often accompany purpura to the latter is not clear, and there seems ground for believing that they are not always rheumatic, but may be due to hæmorrhages into the synovial membranes of the joints.

Symptoms.—Although, as has been stated, cutaneous hæmorrhages may occur under such a variety of conditions that they can scarcely be looked on as characteristic of a definite disease, yet since they not infrequently appear in apparently healthy persons, and run a definite course, it seems advisable to retain the time-honoured name of purpura in these cases, as well as to include under the generic name two or three minor species. It must, however, be distinctly understood that *there is no abrupt line of demarcation between any of the varieties of purpura*, but that the difference between them depends on the severity of the accompanying symptoms. The eruption has the same general characters in all forms of purpura. It consists of isolated spots, whose colour varies from bright red to a livid or dark purplish-red. They do not disappear on pressure. Their shape is generally round or irregular, and their edge is almost always uneven and denticulated. Their size varies usually from that of a pin's head to that of a pea or bean, but in some cases they may be as much as several inches in circumference. The smaller spots, not larger than a finger-nail, are termed 'petechiæ,' the larger 'ecchymoses.' If they take the form of lines or broad stripes they are called 'vibices.' The spots are usually level with the skin, but they sometimes appear as small conical papules round the hair-follicles (*purpura papulosa, lichen lividus*—Willan), or as wheal-like nodules (*purpura urticans*). Very rarely the epidermis is raised into the form of bullæ containing serum and blood-corpuscles (*purpura bullosa*). The duration of each spot depends on the amount of extravasated blood giving rise to it, and on the time necessary for its absorption; but it usually disappears in a week or ten days. The spots, once formed, do not increase in size except by fresh hæmorrhage in their vicinity. They never end in desquamation, and only large ecchymoses are followed by more than transient pigmentation; but they all undergo colour-changes during absorption, by which they become brown, green, and yellow, while their edges become more and more indefinite. Their presence under the skin is unattended with pain or any kind of irritation or pruritus, so that the patient may only discover their existence accidentally while undressing.

Varieties.—We may now briefly consider the varieties of purpura:—

1. **Purpura Simplex.**—In this form the eruption is either preceded for a few days by languor and loss of appetite, or else it occurs without any previous symptom. The spots may be limited to the feet or legs, or they may be scattered over the whole body, including, in severe cases, the head and face. They come out in crops, each of which lasts from eight to ten days. There may be only one or two crops, or fresh ones may protract the disease for several weeks or months.

2. **Purpura Hæmorrhagica.**—Synon.: Land Scurvy; *Morbus Maculosus Werlhoffii.*—This form only differs from purpura rheumatica in the greater depression and constitutional disturbance which precede and accompany the outbreak of spots; in the greater extent of surface covered by the petechiæ; in the larger size of the ecchymoses; and, lastly and chiefly, in the occurrence of hæmorrhagic effusions beneath the mucous membranes of the lips, cheeks, gums, and palate, and of more or less copious free hæmorrhages from the nose, mouth, intestines, urinary tract, and more rarely from the lungs. The repetition of these hæmorrhages may rapidly exhaust the patient's strength, and cause death from anæmia

and collapse, or he may die with so-called 'typhoid' symptoms. The hæmorrhages from internal parts do not bear any necessary proportion to the skin-eruption, and they may be very severe when the latter is small, or *vice versâ*; nor need they begin or end at the same time with it. Purpura hæmorrhagica may, like the other varieties, occur suddenly in apparently healthy persons, living under the most favourable circumstances.

3. **Purpura (Peliosis) Rheumatica.** This is now classed with the polymorphic erythemata; neither the arthritic symptoms nor the character of the eruption present is sufficiently distinctive and constant to separate it from the erythemata, with which it has close alliances. *See* ERYTHEMA.

DIAGNOSIS.—The fact that the purpuric spots are unaltered by pressure, and unattended with itching, scaliness, or tendency to discharge, will separate them from almost every other affection of the skin. From scurvy, purpura is distinguished by occurring in those whose health has not been impaired by long privation from fresh meat and vegetables; by the absence of spongy gums, painful brawny swellings of the limbs, and ulceration of the skin; and by its resistance to diet and the use of lime-juice. Purpura simplex must not be confounded with flea or bug bites.

PROGNOSIS.—In purpura hæmorrhagica recovery is the rule in uncomplicated cases, though there are a few instances on record which ended fatally from the exhaustion produced by repeated hæmorrhages, although no cause could be detected, and every known remedy was tried. Purpura accompanying organic disease, such as Bright's disease or morbus cordis, is unfavourable. The duration of all the forms is very uncertain, owing to their tendency to relapse.

TREATMENT.—In the treatment of purpura absolute rest in bed is necessary, if the eruption be general; elevation of the legs is advantageous if the disease be confined to them. Any derangement of internal organs must be remedied, if possible. As a rule, tonics, especially quinine and iron, do most good in purpura simplex. Tincture of perchloride of iron, ♏xv.-xx., three times a day, is almost a specific in many cases; and the mineral acids, especially sulphuric acid, are of great value. In purpura hæmorrhagica, with copious bleedings, ergot or subcutaneous injection of ergotin has proved most effectual. Turpentine, in ten-minim doses, gallic acid, and other hæmostatics also deserve a trial. Locally, cold applications, or injections of iced water, may be resorted to in severe epistaxis or hæmorrhage from the bowel. Iodide of potassium should not be given in purpura, as it aggravates it in some cases, and has even given rise to serious ulceration.

EDWARD T. SPARKS. ALFRED SANGSTER.

PURPURIC. — Relating to purpura. *See* PURPURA.

PURRING TREMOR or THRILL. SYNON.: Fr. *Frémissement Cataire*; Ger. *Schnurren.*—A physical sign felt by the hand applied over the heart or vessels in certain conditions, resembling the sensation conveyed by the purring of a cat. *See* PHYSICAL EXAMINATION.

PURTON, in Wiltshire. — Saline waters, containing iodine. *See* MINERAL WATERS.

PURULENT INFECTION.—Infection from the absorption of pus, introduced from without, or formed within the body. *See* PYÆMIA.

PUS.—A product of inflammation. *See* INFLAMMATION.

PUSTULE.—SYNON.: Fr. *Pustule*; Ger. *Pustel.*—A vesicle of the skin containing pus, as in small-pox and ecthyma. Vesicles originally containing serum are also apt to become pustules, by a purulent transformation of their contents.

PUSTULE, MALIGNANT.—SYNON.: Anthrax; Fr. *Charbon*; Ger. *Anthrax.*

NOMENCLATURE.—Under this head will be considered the various manifestations of the effects of poisoning by the *bacillus anthracis*, which has already been described in the article on MICRO-ORGANISMS. Various names are employed to designate the different clinical forms, both in man and animals. These names came into use before the real nature of the several forms was known, and were derived from prominent features of the disease, or from its supposed origin.

In bovine animals, the great swelling of the spleen led to the names of 'Splenic fever,' 'Splenic apoplexy,' *mal de rate*, *Milzbrand*, &c. From the peculiar characters of the external lesion in man, and less frequently in animals, the terms 'malignant pustule,' 'anthrax,' 'contagious carbuncle,' &c., were derived. The especial liability of those engaged in certain occupations, especially those involving exposure to contagion, led to the names of 'woolsorter's disease,' 'hair-comber's disease,' &c. And it is very probable that several other diseases of animals, such as Siberian plague of horses, Cape horse-disease, &c., are of similar nature, deriving their special features from the mode of inoculation, or the peculiarities of the animals affected.

ÆTIOLOGY.—Anthrax is of very wide distribution throughout the world, especially affecting cattle, deer, sheep, goats, and allied animals; less frequently horses. But it can be communicated to nearly all animals by inoculation, and even to some birds and amphibia. Of mammals, herbivora are especially susceptible; whilst carnivora are with difficulty inoculated, except when young.

Rodents are highly susceptible, and hence are commonly used for test-inoculations.

Although apparently endemic in certain regions, there can be little doubt that this is due to the great persistence of the contagium by means of its spores, and that the recurrence of outbreaks in cattle is due to the careless disposal of carcasses of animals which have died of the disease.

In man, the disease is usually traceable directly to inoculation from the carcass, or from parts, such as the skin or hair, which have been kept in a dry state. Hence butchers, shepherds, and stockmen, who flay the carcass or bury it, are most commonly its victims from the more direct mode of inoculation; whilst wool packers and sorters, horsehair cleaners, workers in felt manufactories, furriers, tanners, and the like, are exposed to the less direct form. But in rarer instances no such mode of contagion can be traced, and it is probable that in these the poison has been conveyed by flies, or similar agencies. The flesh of the dead animals can rarely be suspected, unless it is eaten raw or very imperfectly cooked. Even then, as we know from experiment, large quantities of the bacillus or its spores may do no harm. Butter and milk are alleged by Heusinger to be possible carriers of the poison. Nor is it improbable that the use of water which has been contaminated by wool-waste, bone-dust, or other substances, may convey contagion to cattle. But none of these modes is proved to be common in man, and the spread of contagion from one human subject to another is extremely rare.

It will, however, be shown that in man the disease may be acquired either by inoculation or by inhalation of the dust containing the spores of the bacillus, perhaps also by swallowing them.

Description. — The form of the disease depends on the mode of entrance, and may be internal or external.

Anthrax in Cattle.—This will be briefly described, as of importance in relation to man. Whereas in some animals there are marked external manifestations, either pustular or of the nature of diffuse phlegmonous swellings, with glandular enlargement, such conditions are rare in cattle. In them there may be not only no external changes, but even few perceptible symptoms. Only for a few hours before death there may be evident languor, loss of appetite, and then stupor. But sometimes animals may be found dead in the morning which had been apparently well the night before. If, however, they are carefully observed, it is usually found that there is marked rise of temperature, followed by coldness and lividity before death.

On examining the carcass, the blood is often found fluid, and may be dark in colour. Sometimes there are glandular swellings and inflammatory œdoma, especially around the pharynx, œsophagus, and stomach. But these are more frequently absent, and there are only scattered hæmorrhages here and there, especially in the lungs and heart-wall, and sometimes in the submucous tissues.

The most constant and characteristic condition is the enormous swelling of the spleen, which is engorged with blood, and readily breaks down on slight handling. This splenic enlargement, be it remembered, is constant only in cattle, and may be entirely absent in other animals, or very slight and irregular.

Microscopic examination shows enormous numbers of anthrax bacilli in the blood, especially in the spleen, lungs, and, next in frequency, in the capillaries of the glomeruli of the kidneys, and sometimes in the liver. In these organs many of the capillaries may appear to be completely filled at parts with bacilli.

It is very important to bear in mind that this abundance and this distribution of the bacilli are very inconstant in other animals. Only guinea-pigs show a similar condition with any constancy. In other animals the bacilli may be few and scattered, being found

Fig. 134.—Part of the Spleen of a Guinea-pig which died of anthrax, showing the relative proportion of bacillus rods and leucocytes. × 100 diam. From a photomicrograph.

especially in the capillaries of the lungs and kidneys ; or they may be mainly limited to the lymphatics, including the glands and lymph cavities. Hence, whilst all parts of the body of cattle which have died of the disease are actively poisonous, it may be difficult to convey the disease from other animals except by inoculation of the fluid from the more affected parts.

Moreover, the activity of the bacillus is rapidly destroyed by decomposition, so that no results may be produced by inoculation from the dead animal when decomposition has set in, unless spore-formation has occurred. This is also true of the human subject.

Spore-formation is sometimes alleged not to occur during life. It may, however, do so in the kidney, if the bacilli pass into the urinary tubules, and also in serous exudations in the pleura and elsewhere, either before or very speedily after death.

Destruction of the carcasses by fire or by

deep burial is essential to prevent infection from them.

Anthrax in Man.—This is divisible into two primary forms, *external* and *internal*, which differ not only in the character of the disease, but in mortality and treatment. The external variety may be further described as *malignant pustule proper*; and *anthrax œdema*. The internal form may be subdivided, according to the part specially affected, into a *broncho-pulmonary* form, of which 'wool-sorter's disease' is the type; and a *gastro-intestinal* form. There may also be cases which do not come strictly under either of these heads, but more closely resemble the disease in cattle, and have been called *Anthracæmia*.

The external form, malignant pustule, is caused by direct inoculation of the skin, or of a superficial mucous membrane, for instance, that of the lip or the eye. In some cases there is only present an intense inflammatory œdema, which spreads like erysipelas, and causes enlargement of the corresponding lymphatic glands. It is like the condition to be immediately described, differing only in the absence of the characteristic pustule.

Of these cases of so-called *anthrax œdema*, it need only be said that some may not be due to the anthrax bacillus, but to the bacillus of malignant œdema, which is described under MICRO-ORGANISMS. But there is no reason to doubt that a similar condition may be produced by the anthrax bacillus.

Malignant Pustule Proper. — The typical form, malignant pustule, can usually be traced to direct inoculation. It commences as a small red swelling or pimple at the point of inoculation. It may give rise to slight irritation, or be attended by burning or itching, but may be absolutely painless. It occurs commonly on the face, neck, hand, or arm, that is, on the parts most exposed to direct inoculation in handling a carcass. The exact period after inoculation at which it appears is variable, owing doubtless to the presence or absence of a small wound: it may be from a few hours to two or three days, possibly longer. Once formed, it rapidly extends, so that in a few hours a large red swelling may be present. There then usually form upon the surface of the swelling one or more vesicles, which, if not ruptured, may reach a considerable size by confluence. By this time a more marked localised swelling has formed; and if the vesicle or bleb ruptures, or is opened, it discharges a watery fluid, either clear or slightly turbid, and often deeply blood-stained. Beneath the vesicle is a dark-red area, which usually dries, producing a dark-brown or black eschar, seated on a much raised, angry red, indurated base. Further vesicles frequently develop around this eschar; they often form a narrow ring surrounding it. The central necrosed area enlarges, and by this time a widespread livid red area and extensive brawny œdema extend from it, sometimes involving the whole arm or face. The corresponding lymphatic glands usually enlarge, often to a great degree, forming a dense mass, owing to the surrounding inflammatory œdema. The central black eschar may enlarge till it reaches one-third to three-quarters of an inch in width; and if the patient survives it may still be distinct, seated on the raised indurated inflamed base, at the end of ten days or more. These characters will be explained in considering the microscopic changes.

In some cases, this typical lesion is indistinct, the brawny red swelling, with some irregular vesicles, being alone observed. When recovery occurs, the swelling subsides more or less rapidly, the eschar separates, and healing takes place rapidly; but the swelling of the glands may last for some time.

Similar carbuncular swellings, more or less typical in character, have also been observed, though rarely, after an internal or general infection, and not as the result of local inoculation.

Microscopic Anatomy of the Malignant Pustule.—The descriptions given by various writers of the changes seen with the microscope are somewhat conflicting. The differences are partly accounted for by the different site or stage of the specimens examined. From an examination of numerous specimens at various stages, the changes appear to be fairly constant in their mode of evolution.

In the early stages there may be no indication of abrasion of the skin, and it is probable that the virus may gain access by the hair-follicles. There is at first infiltration of the corium, with inflammatory exudation, especially in its papillary portion. The epithelium becomes partially separated, and rises in the form of vesicles, as in an ordinary blister, the deeper layers alone remaining attached. Bacilli are found, though scantily, in the serous-exudate.

There then ensues a deeper-seated exudation, penetrating to the deeper layers of the skin. This exudation is accompanied by hæmorrhage, and the tissue-elements swell and undergo rapid necrosis. Both the epidermis and the infiltrated superficial layers of the skin necrose and form a coagulated mass, which constitutes the dark central area of the pustule. Around this the processes of vesication and of subjacent hæmorrhagic infiltration go on spreading, both laterally and in depth.

When fully formed, the central part forms a dense, horny-looking, blood-stained mass; beneath and around it are great infiltration, hæmorrhages, and commencing necrosis. Farther out there is œdema and great vascular engorgement, often with but scanty leucocyte exudation.

In sections stained for bacilli, they are found almost solely in the vesicles and in the lymphatics around the necrosed area. They occur as scanty clusters, and are often most abundant in the more superficial lymphatics. They can be traced for a certain distance from the area of intense inflammation. Their absence in the necrosed area is doubtless explained by the necrosis in which they share. They have occasionally been seen in large numbers amongst the epithelial cells and in the superficial layers during the early stages of infection.

In more advanced conditions, leucocyte infiltration becomes abundant around the necrosed area.

Some have supposed that the peculiar characters of the pustule are due to the presence of other micro-organisms, which aid in their destruction and in the necrosis of the tissues. It cannot be said that microscopic examination of pustules in the earlier stages lends much support to this view, or to the view that leucocytes are much concerned in their destruction. They point rather to an intense irritant action of the products of the growth of the bacteria on the tissues and vessels, differing markedly from their effects as seen in the blood-vessels of the cow, in which almost no such action is apparent. When the surface has necrosed, other bacteria do no doubt enter, but they do not usually penetrate deeply into the tissues.

The normal limitation to the lymphatics, and their scanty number, the spread mainly in the superficial lymphatics, and the early and intense protective exudation and necrosis which they excite, are all favourable to recovery; and they afford strong grounds for the avoidance of any treatment which will break through these natural barriers and produce risk of contamination of the blood.

Symptoms.—The condition of the patient is very varied. Even in cases which prove fatal, there may be few or no general symptoms at first, and he may even continue at work with a large distinct pustule; or there may be only a slight degree of prostration, with a little fever. In some cases recovery ensues without the development of any general symptoms.

More commonly the development of the pustule and of the lymphatic infection are attended by prostration, fever, and some of the symptoms of general blood-poisoning. The exact character of the symptoms, which will be more fully described under the head of 'Internal Anthrax,' appears to depend on the system which is more specially involved. In some, gastro-intestinal derangement, with severe vomiting, is prominent. In others, delirium, convulsions, and coma occur. In rarer cases, the course resembles that of the bronchial form, to be described later.

The temperature is said by some not to be elevated. This may possibly be true in some cases in which there is no general infection, but it is not confirmed by cases investigated by Mr. Spear and the writer, or by the numerous medical men under whose care these patients were, and who had carefully watched other cases. The elevation may be slight at first, and in the more advanced condition the surface temperature may be subnormal; but the rectal temperature is elevated. It may rise to from 101° to 105° F., and in one fatal case it rose to nearly 107°. This point is of considerable importance in diagnosis.

Recovery may take place without special treatment, even where severe constitutional symptoms have supervened. The mortality appears to be about one in four of cases treated without incision. Convalescence may be rapid and complete, or prolonged debility may result.

In some cases, the diffuse cellulitis which spreads from the seat of inoculation may be followed by suppuration, either diffuse phlegmonous infiltration or localised abscess, especially in the glands. The occurrence of diffuse phlegmonous cellulitis appears to be commoner in a class of cases in which the carbuncular swelling is not fully developed, but forms only a small swelling, which usually vesicates. In these cases, also, blebs may form more widely over the inflamed skin, and extensive desquamation of the cuticle may accompany recovery.

Treatment.—When any local lesion forms in a person who is known to be exposed to infection, treatment should be at once commenced. If small, the pimple should be incised with a very sharp knife, and suction immediately applied by means of a cupping-glass or artificial leech; the part should then be thoroughly washed with a strong antiseptic, such as solution of biniodide of mercury 1 per cent. in excess of iodide of potassium, or corrosive sublimate of the same strength, preferably combined with peroxide of hydrogen to prevent coagulation.

If the condition is evidently anthrax, or there has been known inoculation, the more radical method of complete excision and subsequent cauterisation is probably desirable. Of the various methods which may be used, excision is perhaps the best, if it can be done speedily and with little disturbance of the part; but it must be borne in mind that the great risk to the patient's life is in the entrance of the bacilli into the blood-stream, and that the greatest precautions must be taken to avoid this. During the operation the wound should be kept irrigated with antiseptic lotion, preferably biniodide or perchloride of mercury, 1 in 2,000.

Bleeding from the wound may be encouraged by a loose bandage above, in the case of the arm or hand, the object being to prevent the entrance of bacilli into the veins. Arterial bleeding may of course be controlled in the usual way. Antiseptics should be

speedily applied. Of these, strong carbolic acid or fuming nitric acid is often recommended; but the caustic action of these so limits their sphere that probably sublimate or biniodide is to be recommended, except where a caustic action is desired owing to the difficulty of complete excision, for instance, on the face. For a dressing, biniodide solution is especially to be recommended; and if applied on several layers of lint, covered with oiled silk, forms a sort of poultice which aids to draw out the lymph. Some recommend carbolic acid or other antiseptics, but these are comparatively ineffective. Oozing from the wound should be encouraged rather than checked.

The diffuse cellulitis may, if necessary, be treated by superficial linear incisions or scarifications, the parts being immediately washed with biniodide lotion, 1 in 1,000. A large poultice of iodide of starch paste, to which a solution of biniodide of mercury in a large excess of potassium iodide has been added, in such proportion as to make the poultice of the strength of 1 in 3,000 of biniodide, should then be applied.

The *rationale* of this treatment lies in the fact that the bacilli lie mainly in the lymphatics of the superficial layers of the corium. The risk of promoting their entrance into the blood must always be borne in mind. Surgical interference is therefore to be deprecated, unless the disinfectant treatment can also be carried out.

Internally, the treatment must consist in supporting the strength, especially by concentrated animal diet, and perhaps by large doses of quinine. Strophanthus should be given if the heart's action becomes feeble.

Internal Anthrax.—This term is more strictly applicable to those cases in which the starting-point is internal, usually by entrance of the virus into the respiratory or alimentary passages. But the conditions which follow general infection from an external lesion are closely analogous.

Of the forms which internal anthrax assumes, the *bronchial* and *gastro-intestinal* are the most typical. Internal inoculation may, no doubt, occur in the mouth, pharynx, &c., as well as in the stomach or intestine. Some have supposed that there may be an entrance into the blood, such as appears to occur in cattle, causing a general blood-poisoning without local lesion. But the practical evidence in favour of this view is small, and it is very doubtful if it is really true of cattle.

In those exposed to infection by the inhalation of dust charged with anthrax spores, as wool-sorters, the form of disease is usually bronchial. In all the cases investigated by the writer, in conjunction with the late Mr. Spear of the Local Government Board,[1] this was the form observed; and further investigation of wool-sorter's disease by others since that time has fully confirmed the observations then made, both as to the form of disease and the microscopic lesions.

1. Bronchial Form — Wool-sorter's Disease.—In this form inoculation takes place by the inhalation of dust from wool or hair containing the spores of the anthrax bacillus. The site of inoculation is in the lower part of the trachea and the large bronchi. Local lesions closely resembling those of malignant pustule are here produced in the mucous membrane, and thence the virus spreads by the lymphatics to the bronchial and mediastinal glands. These become greatly swollen, and often the seat of hæmorrhages. Thence infection, with intense inflammatory œdema, spreads to the connective tissue of the mediastinum, and possibly upwards to the neck, to the root of the lungs, and sometimes to the pericardium. Although the pleuræ are rarely inflamed, the pleural sacs become filled with serum, and the lungs collapse. Such are the constant lesions. But the virus may spread to other organs, if once it enters the blood, and may then produce hæmorrhages or inflammatory exudations in them, with consequent symptoms. The alimentary canal, the peritoneum, the brain and its membranes, may be especially affected. But death often occurs before they have become involved.

The symptoms and course of the disease will be better understood if the morbid anatomy is first considered.

Anatomical Characters.—Marked lividity is common, often being present even during life. Some swelling may be seen in the lower part of the neck, though rarely. The blood is dark-coloured, and coagulates imperfectly.

On opening the thorax, some emphysema may be present in the anterior mediastinum. But constantly there is seen a diffuse infiltration of the mediastinal tissues, either pale and gelatinous, or deeply blood-stained, or with scattered hæmorrhages. Both pleural cavities contain a large quantity of fluid, if the two layers are not adherent; the fluid is usually pale and clear, or very slightly turbid. Rarely it is blood-stained. The quantity in each pleura may be from two to four pints. The serous membrane is usually free from all trace of inflammation, though this occurs in rare cases. The pericardium also often contains an excess of fluid. If inflammation is present, it rarely extends to the epicardium.

The lungs are collapsed; they may show minute scattered hæmorrhages, or small patches of broncho-pneumonia, but this not commonly.

The mediastinal and bronchial glands are greatly swollen, and the hæmorrhage in them may make them look like clots. Extensive

[1] See *Reports of the Medical Officer of the Local Government Board* for 1880 and 1881.

infiltration of the whole of the connective tissue around them is present, reaching sometimes up into the neck.

The fluid squeezed from this tissue may contain scanty bacilli, but both here and in the pleural fluid they may be very scanty.

On opening the trachea and bronchi, they are found to contain blood-stained frothy fluid. Towards the lower part of the trachea and in the main bronchi the mucous membrane is irregularly swollen and blood-stained in patches. In addition, hæmorrhages are seen in the mucous membrane, forming raised spots. This condition is usually limited to the main bronchi, but may extend into their primary divisions.

On microscopic examination, the most marked changes correspond to the hæmorrhagic areas. The hæmorrhage lies for the most part immediately beneath the basement-membrane, which may have ruptured, the blood forming a layer beneath the detached epithelium. It may also penetrate deeply into the mucous and submucous coats. All the tissues beneath and around are infiltrated with serum, and their tissue-elements thus separated, but not usually necrotic. The blood-vessels are dilated, but leucocyte exudation is scanty. Dense masses of bacilli are found in the exudation, and escaping to the surface. They also surround and extend in the lymphatics, perivascular and other, and may be traced in them to the deeper lymphatic plexuses. Similar masses of bacilli may also be seen in the superficial layers of the mucosa, where as yet little or no inflammation has occurred. They often lie immediately beneath the basement-membrane. Little or no catarrhal change is seen, the epithelium simply desquamating; if catarrh is present, it is usually of older date.

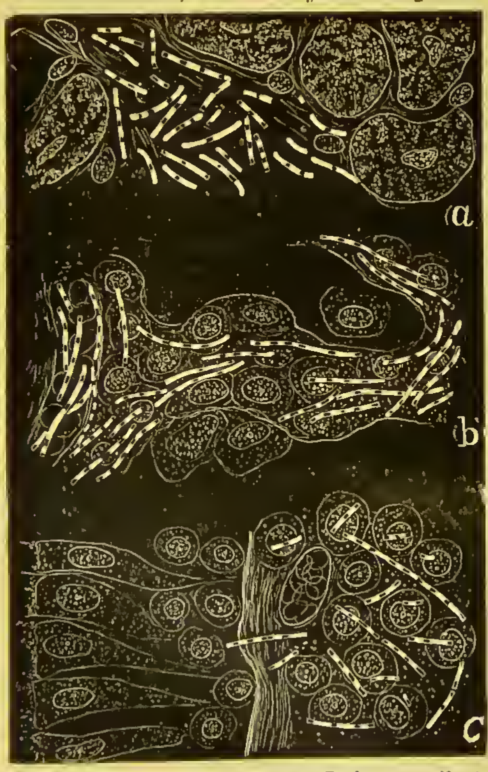

Fig. 135.—Anthrax Bacilli. *a.* In heart-wall of a cow. *b.* In the pulmonary capillaries of a cow. *c.* In the human bronchial mucous membrane, in a case of 'wool-sorter's disease.' × 800 diam.

In the bronchial glands, the condition is often masked by the extensive hæmorrhage. Bacilli are found, often scantily, especially in the lymph-sinuses of the cortex. Sometimes they are very abundant, and may then also appear in the capillaries.

In the lungs, scattered patches of hæmorrhage may be present, mainly due to the inhalation of blood from the bronchi. These may also produce areas of lobular collapse and broncho-pneumonia. But for the most part, nothing but the general collapse and congestive œdema are found in the lungs, and bacilli are often not to be discovered, except here and there in the lymphatics near the root. This common absence of bacilli in the pulmonary capillaries proper is in marked contrast with the condition usual in cattle.

In other organs, the changes are diverse, and may be absent. There is not usually much cloudy swelling or other indication of septicæmia, though they may be present.

Fig. 136.—Bacilli from the fluid exuded from the lung in a case of internal anthrax. *a.* Red blood-corpuscles. *b* and *c.* Large granular corpuscles from the lung. *d.* Bacilli of various lengths, containing highly refracting granules, or fully formed spores. × about 700 diam.

Minute hæmorrhages are often apparent; or, in the pia mater, and generally in serous membranes, diffuse extravasations. In the stomach and intestines submucous exudation and scattered hæmorrhage may occur.

For the most part, the spleen is but slightly swollen. Examination of the blood and of other organs, such as the kidney, in which bacilli are commonly abundant in many

animals, is usually attended with negative results, though in some cases bacilli may be found by careful search. Inoculation with these parts or with the blood may also produce no effect.

But if susceptible animals are inoculated with the bronchial fluid, or other parts which contain bacilli, typical anthrax is produced.

The multiple nature of the lesion in the bronchi and trachea is no doubt explained by the ready spread of the bacilli in the lymphatics of the mucous membrane, and by secondary inoculation with the bacilli exuded on its surface.

The pleural exudation, which forms so constant a feature in typical cases, usually without any inflammation of the serous membrane, is probably due to the enormous and rapid obstruction of the lymph-channels in the glands and mediastinum. The swelling and obstruction of the bronchi must also aid the collapse of the lungs, by preventing the entrance of air.

A knowledge of these facts is of essential importance in relation to treatment.

Symptoms and Course.—Whilst presenting considerable variety in the additional symptoms and mode of termination, nearly all cases present characteristic features due to the peculiar lesions just described. To these may be added the effects of nerve irritation, especially of the phrenic nerves, the vagi, and the cardiac and pulmonary plexuses.

Only the more important of the clinical phenomena will be described.[1] The earlier symptoms are usually great lassitude, chilliness, sometimes with rigors, and mental depression, sometimes with insomnia. Headache, dizziness, and nausea are often present. Vomiting may occur early, and be a prominent symptom, possibly due to the nerve-irritation above mentioned. With these or other symptoms there is commonly complained of at an early period a peculiar sense of constriction of the chest, especially at the lower part, and a want of breath. This is sometimes accompanied by marked pain or cramp-like feeling, and is aggravated by exertion. Cramps and tingling sensations in the limbs, palpitation, flushings, and perspirations may occur.

After a variable period of from one to five days, during which there may be intervals of improvement, there ensue more severe symptoms, and the patient has to leave work and often to take to bed. These more pronounced symptoms include greatly increased prostration, accelerated and difficult respiration, usually rise of temperature, and a rapid and feeble pulse. In addition, the sense of painful constriction of the chest is often marked. Cough, which may be slight or almost absent at first, now usually becomes marked; it is dry, hacking, and painful. The sputa are usually scanty, frothy, and blood-stained, but may become abundant and hæmorrhagic. Bacilli may be found in the sputa. (Lodge.[1])

Sometimes death occurs from syncope within twenty-four hours after the patient gives up work, nothing but the dyspnœa and cyanosis being observed.

More commonly the dyspnœa and cyanosis increase, the face becomes pallid or livid, the pulse and respiration are accelerated, and the general symptoms become more marked. Headache is sometimes intense; vomiting may be frequent and urgent, and indications of the involvement of other organs show themselves. Of these, gastro-intestinal irritation is frequent; there may be severe colic; hæmorrhage from the bowels may occur, though infrequently. In fact, the disease may assume the gastro-intestinal form. Or the cerebral or spinal centres may be especially involved; hence delirium and somnolence, more rarely convulsions or tetanic spasms. Death may be preceded by coma, or the patient may be conscious to the last.

In many cases scattered hæmorrhages in the skin or subcutaneous tissue, or diffuse discolorations, are observed during life, but they may be entirely absent. In rare cases typical carbuncles have been observed. Remissions sometimes occur, to be followed by more marked prostration. In nearly all cases, even if the temperature is high, there is great coldness of the extremities, with indications of asphyxia.

The range of temperature is very variable, and it shows also marked oscillations; but observations on the surface temperature are not reliable, owing to the great chilling of the surface.

Of the physical signs, those of pleural effusion are the most marked, but the effusion sometimes occurs very rapidly, and may not do so till shortly before death. Bronchitic sounds, &c., may of course also be present

Even when severe symptoms have developed, recovery may take place. In the cases collected by Mr. Spear, four out of twenty-three recovered. And in many cases which presented marked initial symptoms, and from their relations to infection were in all probability cases of the disease, the more severe symptoms did not develop. In some, secondary changes in the lungs appear to have caused death at a much later period.

Death usually occurs within from two to six days from the onset of marked symptoms. Eleven of the twenty-three cases mentioned died within three days. Only two died at eight days, and these from septic complications.

[1] For further details, see the admirable report by Mr. Spear, already referred to: *Report of Medical Officer of the Local Government Board*, 1880, p. 72.

[1] *Arch. de Méd. Expérimentale*, ii. 1890, p. 763.

When recovery occurs, convalescence is often very prolonged.

TREATMENT.—Prophylactic measures are by far the most important. Of these the careful separation and disinfection by superheated steam of all wool or hair which shows suspicious characters, such as excess of blood-staining, dirt, &c., or which comes from districts where anthrax is common, are of prime importance. The characters and origin of such wool or hair are well known to those engaged in such trades. Next in importance are the thorough ventilation of the rooms in which the wool is sorted, and the greatest care in washing the hands, changing the clothes, &c. The effect of such precautions, which were first enforced in 1884, has been to reduce the mortality from the disease in the Bradford district to two per annum during the years from 1884 to 1890 inclusive; whereas in the period of ten months at the time of our inquiry in 1879–80 there were nine cases of malignant pustule with two deaths, and twenty-three cases of internal anthrax with nineteen deaths. (Lodge.[1])

Of the treatment to be adopted when the fully pronounced symptoms are present, little can be said. The evacuation of the fluid from the pleuræ is certainly indicated, and the internal administration of strong meat broths, stimulants, and cardiac tonics, especially strophanthus. But when once the virus has entered the blood, it is probable that little can be done beyond dealing with complications as they arise.

Prophylactic inoculation does not appear to be applicable. Moreover, it does not appear that one attack affords protection in man, since internal anthrax has been fatal in some who have suffered previously from malignant pustule.

2. **Gastro-Intestinal and other Forms.**—Of the other forms of internal anthrax it need only be said that they appear to be far rarer, and that their symptoms and treatment correspond with those described above, when they occur as complications of the bronchial form. A few cases are on record in which the disease has followed eating parts of animals which have died from anthrax, as flesh, liver, &c. In these cases lesions were found in the stomach, intestines, &c. corresponding to those described in the bronchi in wool-sorter's disease; the mesenteric glands showing a condition resembling that of the bronchial glands.

The symptoms in such cases are mainly abdominal, and the disease is usually rapidly fatal.

It is questionable whether many of the cases which have been described as gastro-intestinal, or *mycosis intestinalis*, and especially where there is a phlegmonous gastritis, are not due to other bacteria. In none of the cases which the writer has examined have anthrax bacilli been found; in some only micrococci were present; in others, bacilli which, though bearing a superficial resemblance to anthrax bacilli, proved to possess entirely different characters. Microscopic examination and inoculation of animals can alone decide in any particular case.

W. S. GREENFIELD.

[1] *Loc. cit.* p. 761.

PUTRID FEVER.—A synonym for typhus fever. *See* TYPHUS FEVER.

PUTRID SORE-THROAT.—Sloughing ulceration of the throat from any cause such as diphtheria, scarlatina, or syphilis *See* PHARYNX, Diseases of; and TONSILS Diseases of.

PYÆMIA (πῦον, pus; and αἷμα, blood).—SYNON.: Purulent Infection; Fr. *Pyohémie*; Ger. *Pyohämie*; *Pyämie*.

DEFINITION.—A condition of blood-poisoning which gives rise to fever, accompanied either by severe visceral inflammations and congestions, or by certain local lesions, which are chiefly venous thrombosis, embolic abscesses in the viscera, acute suppurations of the serous membranes and joints, multiple abscesses in the connective tissue, and eruptions upon the skin. The disease is usually, but not always, sequential to a wound or injury.

ÆTIOLOGY AND PATHOLOGY.—The initiatory symptoms and the anatomical characters of pyæmia are such as point clearly to the introduction of some morbid material into the circulation, and not unnaturally gave rise to the idea, upon which the name of the disease was founded, that this material was pus. Several considerations formerly appeared to favour this belief, amongst which were especially these. Hunter believed that the lining membrane of a vein secreted pus. Now, as cases of pyæmia were found to be very commonly associated with phlebitis, and also with what were thought to be deposits of pus in the viscera, a very simple explanation of the disease seemed to be that the inflamed vein secreted pus, which became mixed with the blood, and was carried by the circulation to some distant organ, wherein, being arrested, it formed the focus of a suppuration.

Hunter observed that in cases in which an injury to a vein proved fatal, the coats of the injured vein were swollen and thickened, and its lining membrane was of an unusually red colour; and he supposed that the fragments of fibrin and the softening clots often found in such veins were the products of an inflammation of their lining membrane, which in the one case was of an adhesive, in the other of a suppurative character. He believed that the coagula generally found in inflamed veins were the means whereby these inflammatory products were prevented

from being carried into the circulation, and that if such coagula were not formed, pus secreted by the inflamed vein might be mixed with the blood, and thus distributed.

Hunter, though perfectly familiar with the secondary abscesses of pyæmia, does not seem to have connected them with the introduction into the blood of morbid material from a wound. That these abscesses were the result of an entrance of pus into the blood, and the arrest of pus-globules in the capillaries of the affected organ, was maintained by others, who thus looked upon the process as a mechanical transference of pus-cells from one part of the body to another. These observers supposed that in healthy wounds the entrance of pus into the veins was prevented by the formation of a coagulum, but that, if this coagulum were not formed, or became broken down, pus entered the circulation, and gave rise to the secondary abscesses by its arrest in distant organs. This view was supposed to be confirmed by Cruveilhier's experiments, in which he injected mercury into the veins, and found that abscesses were formed in the first set of capillaries to which these veins were distributed, and that such abscesses were formed around a globule of mercury. Thus, if the injection were made into the systemic veins, the abscesses were formed in the lungs; if into the portal vein, they were formed in the liver.

But this explanation of the phenomena of pyæmia was soon found to be insufficient, and also to be incompatible with many facts since ascertained. Cases of pyæmia occur in which there is no primary suppuration from whence the pus could be derived; there is no evidence that the lining membrane of a vein ever secretes pus; the secondary abscesses of pyæmia are not deposits of pus, but true inflammations, and, if examined at their commencement, are found not to be purulent. Again, the first set of capillaries occasionally escape, and the secondary lesions occur in parts beyond them in the order of the circulation; and the position of the abscesses—as, for instance, in the lung, where they chiefly occupy the lower parts of the organ—is not explained by the purely mechanical theory. Besides which, there are the general symptoms of systemic poisoning to be accounted for, and these are sometimes so severe as to kill the patient before any secondary lesions are developed. Experiments upon animals show that the injection into the veins of pus, or any material containing solid particles, is usually followed by the arrest of the solid particles in the first set of capillaries with which they meet, and a consequent obstruction of the capillary circulation; but the result of this capillary obstruction varies according to the nature of the obstructing substance. The injection of septic liquids filtered from solid particles causes fever and other constitutional symptoms, varying according to the virulence of the poison contained.

An examination of the symptoms of pyæmia will show that it consists of two series of morbid processes, the first series manifesting the general constitutional disturbance due to the systemic poisoning, the second having relation to the secondary lesions thereupon developed. Both analogy and morbid anatomy point to the primary cause of these being the introduction into the blood of an animal poison, which at once gives rise to the first series or the general disease; and we shall see that the secondary lesions are to be accounted for, either by a venous thrombosis, leading to a capillary embolism, or by a stagnation of the diseased blood and the changes which ensue thereupon.

Of the exact nature of the poison which gives to the blood in pyæmia its infective character, we are in ignorance; and it is better to admit this. Our powers of organic analysis are not yet sufficient for the isolation of the subtle but potent poisons upon which so many of the specific diseases depend. Micro-organisms are usually found in the blood; and though the part they play in connexion with pyæmia is not yet exactly and with certainty defined, there is good reason to believe that upon their presence and action depend the most important phenomena of the disease. Even though in some cases of pyæmia it may not be possible during life to discover in the blood the characteristic organisms, yet nevertheless the poison may have been elaborated by such organisms and introduced from without, or the organisms which have produced it in the body may since have undergone destruction. But wherever and however the poison be generated, and whether or not it be *necessarily* connected with the *presence* of micro-organisms, it seems certain that there are predisposing causes which render a person peculiarly prone to its generation or reception.

Of predisposing causes, impure air, and especially that kind of impurity which results from the presence of decomposing animal matter, is doubtless one of the most important. Thus the crowding together of a number of persons with suppurating wounds, neglect in removing the discharges and excretions from sick persons, and imperfect drainage, are causes favouring the development of pyæmia. The puerperal condition is also a powerful predisposing cause. Disease of important excreting organs, whereby effete materials are retained in the blood, also renders a person more liable to pyæmia, as is often observed in cases of Bright's disease; and any great nervous depression (perhaps because of its influence in diminishing excretion) has a like effect. Intemperance, and acute fevers, probably render their subjects somewhat more prone to pyæmia; but it is a mistake

to assert that chronic invalids, or persons in weak health, have any special liability to the disease. Children, though by no means exempt from, are somewhat less liable to, pyæmia than adults.

Pyæmia, then, is caused by the entrance into the blood of an animal poison, which in the majority of instances originates in a wound, an injury, or a local inflammation; but in some few cases it has been impossible to determine where the disease began. This poison under favourable conditions multiplies in the blood; that is to say, its introduction gives rise to an infective process which is connected with the presence and development of micro-organisms.

Pyæmia is especially liable to follow certain diseases and injuries, and, before the introduction of antiseptic surgery, used to be the gravest danger of many operations. Thus, it has been observed in frequent association with compound fractures, and operations involving the section of a bone; after injuries of the bones of the head, and in connexion with acute necrosis of the long bones from suppurative periostitis; also after wounds or injuries of veins; after parturition; in connexion with diffuse cellular inflammation, suppuration of the internal ear, and operations upon the urinary organs. Facial carbuncle is a disease peculiarly prone to lead to pyæmia.

Anatomical Characters. — The morbid anatomy of pyæmia reveals two series of changes—the one depending upon the primary infection of the blood, the other upon the secondary effects of this. When the blood is very profoundly infected, the results of general blood-poisoning are often all that can be found; the patient dies before the secondary affections can be produced. When the poison is less virulent, or not much in excess of the eliminative powers, or meets with conditions unfavourable for its development, the secondary lesions predominate, and in some instances are alone discoverable; but in most cases changes of both kinds are found.

The wound, or the tissues at the site of the primary disease or injury, from whence the poison has entered the blood, may be found in various conditions. There is often, but not always, suppuration present, and the wound is bathed in foul and unhealthy pus; or the wound may be dry, and discharging only a little thin ichor; or the cellular tissue may be infiltrated with sero-purulent fluid. The veins in the neighbourhood of the diseased tissues are often found blocked with coagula, extending a variable distance along their channels, and in different stages of disintegration. These clots may be soft and dark, or firm and adherent to the lining membrane of the vein, and partially decolorised; or they may be broken down in the centre to a reddish-yellow pulpy material, consisting of disintegrated fibrin. Sometimes the whole clot is thus softened, and the fragments of fibrin have been partly carried away into the circulation. Occasionally, but rarely, the clots contain real pus; but the puriform material found in the vessels is usually only broken-down fibrin, and the *débris* of cells.

An abscess may, however, open into a vein, and thus pus may gain a direct entrance into its channel; in such a case a coagulum, consisting of a mixture of pus and blood, is found in the vessel, and we have a true purulent clot. Softening thrombi are found with especial frequency in connexion with injuries and diseases of bone, as, for instance, in the sinuses of the dura mater after bruising of the cranial bones, or in consequence of caries of the bones of the ear; or in the veins of an unhealthy stump, in which there is inflammation or necrosis of the bone.

But it may be certainly affirmed that many cases of pyæmia occur in which no thrombi are found, and in which the most careful examination fails to detect any morbid condition whatever of the veins. It is necessary to point this out, because it has been erroneously asserted by some that phlebitis is an essential process in the disease. It is to be observed also that the presence of pus is not a necessary element in the causation of pyæmia, as was once supposed; well-marked cases have been seen in which there has been neither wound nor suppuration for its origin. When a wound does exist, however, it is usually found in an unhealthy condition, and in this may probably be found the explanation of the spread of pyæmia by contagion. Healthy granulations do not allow the entrance of septic matter into the blood; a wound may be bathed with fœtid fluids of a most poisonous character, and yet none may be absorbed, as has been proved experimentally by Chauveau; but if the surface of the wound becomes unhealthy, the granulations no longer present a barrier to the absorption of poisonous fluids. This may be due, as Sir William Savory has suggested, to the dialysing property of animal membranes. If, then, the secretions or exhalations of an unhealthy wound come in contact with another secreting surface, an unhealthy action may thereby be set up on that surface, producing a condition favourable to the production and absorption of poisonous material. This explains the prevalence of pyæmia where a number of persons with open wounds are crowded together. A similar condition of wound may also be induced by neglect of other sanitary precautions, especially by the presence of decomposing animal matter, and the escape of sewer-gas into the air surrounding the patient.

In cases of acute pyæmia the morbid changes found *post-mortem* are chiefly congestion and softening of the viscera, local stagnation and extravasation of blood, and a general blood-staining of the tissues—con-

ditions indicating profound changes in the state of the blood. In what these changes consist we are at present ignorant; but usually the blood contains an excess of leucocytes, and its fibrin is diminished in quantity and lacks contractility.

When the disease is not of this acutest form, but is of longer duration, there are developed those secondary lesions which are especially characteristic of pyæmia.

Most notable and commonest among these are the so-called 'secondary deposits' or 'secondary abscesses' of pyæmia. These are found most frequently near the surface of the viscera, and are the result of the obstruction of the terminal branches of the vessel supplying the part with blood. This obstruction is followed by engorgement and extravasation, by inflammation, and by rapid necrosis or suppuration. It is necessary more fully to describe this process before giving an account of the morbid anatomy of individual organs thus affected. The obstruction may be caused in several ways.

(1) It may be embolic. A portion of a disintegrating clot may be carried into the circulation, until it meets with an artery too small to allow its transmission, or with the first set of capillaries in its route, wherein it becomes arrested. In this way a portion of the organ is deprived of its arterial blood-supply, and in consequence of the absence of the *vis à tergo* of the heart, regurgitation takes place from the veins into the capillaries, and even into the terminal arteries, giving rise to a venous engorgement of the affected region. The nutrition of the capillaries being interfered with by the lack of arterial blood, their walls become altered or necrosed, and extravasation of blood takes place, the area of extravasation corresponding with the part supplied by the obstructed vessel. At the same time the vessels of the tissues immediately surrounding the obstructed region become dilated, and so form a zone of intense hyperæmia. So far, this process is only what occurs in any case of embolism (as, for instance, when minute fragments of fibrin are detached from an inflamed mitral valve), but the importance of the process in pyæmia depends upon the changes which subsequently occur. Now the changes which occur in the tissues of a part the seat of embolism depend upon the character of the embolus. If the embolus come from a part wherein putrefaction is active, the same process will be set up in the tissues in which the embolus is arrested; if the part in which it originates be in a state of inflammation, a corresponding inflammation will ensue; if the embolus be purulent, or come from a suppurating region, suppuration will occur; if it have origin in a gangrenous area, gangrene will usually follow in the spot to which it is carried. It will be seen, therefore, that the area affected by the embolism at first undergoes those changes in nutrition which are common to embolism generally; but to these are added certain special and destructive processes, which vary in their activity and character with the activity and character of the process in progress at the spot from whence the embolus comes. Each of these two changes is modified by the other. The mechanical effects of the embolism pass into the destructive processes set up by the infected embolus; and the destructive processes originated by the infected embolus are expended upon tissues already altered by the mechanical effects of embolism, with results proportionately modified. Thus the suppurative process usually leads to the formation of a comparatively small quantity of true pus, which is mixed with a relatively large amount of the *débris* of necrosis.

If, then, the embolus originate in a wound infected with the pyæmic poison, it sets up an unhealthy inflammation and rapid disintegration of the tissues wherein it is arrested. The important difference, therefore, between pyæmic and other embolism consists in the fact that the pyæmic embolus is composed of *infected* clot. It has been by some maintained that this is the sole mode of production of the secondary pyæmic formations. This is incorrect, for, although such formations doubtless often have such an origin, they may also arise in a different manner. The embolic theory will not account for cases in which the first set of capillaries in the order of the circulation from the seat of injury escape, and secondary deposits are found in other organs beyond; as, for instance, where they occur in the liver after an injury of the head, and the lungs are not affected. Neither does this theory explain the cases in which the joints only are affected, as in connexion with gonorrhœa or scarlatina; nor are the chronic cases in which only superficial abscesses occur thus explicable. It must be remembered, too, that the lesions in the lungs are found chiefly in the inferior parts of the organ, which is not what would be expected were their origin always embolic.

(2) The capillary obstruction may be caused by a local stagnation depending upon the poisoned state of the blood. The infection of the blood interferes with the normal interchange between this fluid and the tissues, and produces a tendency to coagulation in the minuter vessels. This coagulation is especially prone to occur in organs or parts of organs already congested, for where the circulation is slow the impurity will be the greater. In this way the greater frequency of the secondary lesions in the lower than in the upper part of the lungs is accounted for. When this form of thrombosis has taken place, the part so affected is in a condition similar to that above described as due to embolism, and the same series of changes

ensues. It must be remembered, also, that the impurity of the blood interferes with the nutrition of the vessels, which thus easily allow of the extravasations that are so frequently found, not only in the viscera, but on the surface of the skin and mucous membranes.

(3) Cases are, however, occasionally met with in which the clinical symptoms of blood-poisoning are associated with the formation of visceral abscesses, but in which after death no evideuce of either embolism or thrombosis can be discovered.

(4) In another and more numerous class of cases, usually of the less acute kind, the disease expends itself chiefly upon the surface of the body, and abscesses are found in the subcutaneous or inter-muscular cellular tissue, the viscera altogether escaping. Here we often have evidence of a thrombosis preceding the suppuration; and the pus contained in such abscesses is frequently found mixed with considerable quantities of blood-clot in various stages of disintegration.

(5) There is also a group of cases in which the local manifestations of the disease are chiefly or entirely confined to the joints, and certain structures connected therewith, namely, the sheaths of tendons and the fibrous fasciæ.

It has been shown by Dr. Burdon Sanderson that great numbers of microzymes may be found in the blood and inflammatory exudations of animals suffering from acute infective fever, produced by inoculation of septic matter. Others (Wilks, Moxon, Goodhart) have failed to find bacteria in the blood of living cases of pyæmia, though they may be found in great numbers after death. The committee appointed by the Pathological Society 'to investigate the nature and causes of those infective diseases known as pyæmia, septicæmia, and purulent infection,' state that, 'although bacteria of various forms were found in the blood in a number of cases, they could not be found in all the cases, nor were they discovered constantly in those cases where at one or other time they were present' (*Trans. of Path. Soc.*, vol. xxx. p. 44).

But the arrest of micrococci in the tissues in connexion with the thrombi and emboli so frequently observed in pyæmia would seem with great probability to be the important factor in the production of the secondary abscesses. The conditions are just such as would favour the development of these organisms, and the success of their attack upon the tissues; that is to say, the micro-organisms are arrested in a part which is rendered vulnerable by the interference with its blood-supply and the consequent impairment of its nutrition, while, at the same time, the access of the leucocytes to the micro-organisms is impeded, and their power of incorporating and destroying them diminished. But for the attainment by the micrococci of a harmful ascendency in the tissues there is also necessary a certain degree of susceptibility on the part of the infected individual, and we do not yet know precisely in what this susceptibility consists, or how it is produced. There is this notable fact, moreover, which gives great countenance to the importance of micro-organisms in pyæmia—that since the general adoption of the antiseptic method of treating wounds, the basis of which is the exclusion or destruction of these micro-organisms, the number of cases of pyæmia has been enormously diminished, and that as a sequence of operations performed with antiseptic precautions it is almost unknown.

It is difficult to explain the occurrence of the joint-affections, and the especial vulnerability of certain organs to the secondary inflammations of pyæmia. All that can be said on this part of the subject is that the poison of pyæmia selects certain organs and tissues wherein to expend itself, just as that of rheumatism, syphilis, or typhoid fever does.

Having thus far considered the general pathology of the disease, it will be convenient to pass to the morbid anatomy of individual organs. The *lungs* are usually congested throughout, and are very prone to the secondary lesions. These are found chiefly near the surface and in the lower and posterior portions, and consist, in the early stage of the process, of small extravasations and patches of congestion; the minuter branches of the pulmonary artery are herein found plugged with coagulum; and hæmorrhage, or inflammatory exudation, has taken place into the surrounding tissues. Thus we have a patch of pulmonary hæmorrhage, or of lobular pneumonia. Later on, the centre of this area of consolidation is found in a state of necrosis, and its circumference surrounded by a ring of intense congestion. The process of disintegration occurs with great rapidity, and the central portion of the nodule may be found, within forty-eight hours of the first symptom of pulmonary mischief, broken down into a soft yellow puriform material, or even containing true pus. The nodules are perfectly circumscribed, and average in size about that of a hazel-nut, though they may be smaller or larger. On section, they are seen to consist, in the centre, of a cavity filled with pus or puriform *débris*; surrounding this is an area of pneumonic consolidation, the circumference of which is formed by a narrow ring of intense congestion. The surrounding lung is usually simply congested, or it may even be natural in appearance. An examination of the early stages of these changes shows the first step in the process to be a blocking of the minute branches of the pulmonary artery; and this may depend either upon thrombosis or upon embolism; but, in whichever manner it originates, it is

followed by a rapid exudation into, and disintegration of, the portion of lung to which the blocked vessels belong. It has been pointed out that these changes take place chiefly in parts of the lung near the surface. The result of this is that the *pleura* becomes involved in the inflammation, and those nodules which have reached the surface of the lung are coated with a patch of lymph, which may subsequently become part of a more general pleurisy. Or one or more of the abscesses may burst into the pleura, when a rapid effusion of sero-purulent fluid takes place into its cavity.

Pleurisy may, however, occur independently of the lung-disease; and in this case, also, the effusion becomes rapidly purulent. In the early stage of the disease numerous subpleural ecchymoses are frequently found. Pleurisy is especially prone to occur in those cases of pyæmia originating in caries of the bones of the ear, and in children thus affected is often the first symptom of the pyæmic infection.

The *heart* is liable to be affected by the same kind of embolic abscesses as are found in other organs. They occur most often in pyæmia from acute necrosis, in young persons. In the early stage small spots of congestion, due to the plugging of small arteries, are found both on the surface and in the substance of the heart, and also beneath the endocardium. Later on, small cavities containing pus or puriform fluid, and surrounded by a zone of congestion, are found in the walls of the organ. These abscesses are sometimes very numerous, and may occur in any part of the organ; they may open on the surface or into the cavity of the heart; the muscular tissue around them is softened and broken down. The *pericardium* may thus become inflamed from the contiguity of an abscess in the wall of the heart; but, as with the pleura, pyæmic pericarditis may occur independently of such an origin, and in either case the effusion rapidly becomes purulent. The same process may lead to inflammation of the endocardium.

The *brain*, although less frequently the seat of pyæmic abscess than many of the organs, may be the sole organ affected by the secondary lesions; and it not uncommonly happens, when this is so, that the general symptoms are unusually slight. Small extravasations are often found in the subarachnoid tissue. Circumscribed softening, ending in abscess, is most frequent in the white matter of the brain. It commences as a patch of red softening, due to obstructed vessels, which subsequently changes to a reddish-yellow pulp, or to greenish pus, enclosed by a more or less defined wall. Such an abscess may run a very chronic course, and is then found enclosed in a cyst of connective tissue.

The *peritoneum* is occasionally found acutely inflamed, its surface vascular and coated with lymph or pus; in other cases the membrane is spotted with numerous ecchymoses. Peritonitis may also be set up by secondary abscess of the liver making its way to the surface, or even bursting into the abdominal cavity. In some cases of strangulated hernia, death takes place with great rapidity after operation, from absorption of septic fluid which has escaped from the sac into the abdominal cavity. In addition to the usual visceral conditions, the peritoneum is then found vascular, and slightly coated with commencing exudation.

In acute cases of pyæmia the *alimentary canal* may present patches of intense congestion, or numerous small spots of subserous hæmorrhage.

The *liver* is, next to the lungs, the organ in which secondary deposits are most frequently found in pyæmia. In acute cases the organ is found congested, softened, and swollen; it has lost elasticity; and its texture on section is confused and clouded. Secondary abscess is, of course, especially prone to occur in connexion with dysenteric and other lesions of the bowel, but is also found in cases of general pyæmia, originating in any part of the body. It commences by plugging of the portal capillaries, leading, as has been explained with regard to the lung, to congestion and stagnation of blood in the affected portion; the nutrition of this portion being thus interfered with, necrotic changes soon commence, and the infective character of the clot gives the start to destructive inflammation. The capillaries surrounding the diseased area dilate, and inflammatory exudation occurs into its circumference; at the same time central disintegration is rapidly going on; and in a short time we find a purulent collection, surrounded by a zone of exudation and congestion. Occasionally these abscesses run a more chronic course, and become encysted; and it seems probable that the tropical hepatic abscesses, which often attain a large size, have an embolic origin, connected with the ulceration of dysentery, and may thus be classed with pyæmic suppurations. It must be remembered that pyæmic abscess in other parts is not always acute. Sometimes, but more rarely, hepatic abscess originates in embolism of the hepatic artery, in which case the suppurations are usually smaller and more scattered.

The *spleen* may be simply swollen and soft, or may contain abscesses precisely resembling those described in the liver; the same may be said of the *kidneys*.

Inflammation of the *bones* and *joints* may be either the cause or the effect of pyæmia. The frequency with which pyæmia originates in diffuse periostitis and osteo-myelitis is well known. In such cases the heart and kidneys are especially liable to be the seat of secondary deposits, and the disease is generally of

a severe form. The bone is found stripped of its investing periosteum, and separated from it by a quantity of pus. The surface of the bone is bare, and of a yellowish-white colour; the medulla is usually also inflamed, and is tumid and vascular, or it may be infiltrated to a varying extent with purulent fluid. Sometimes, as after amputation, the medulla is the part chiefly affected, and the inflammation extends to a greater distance along the interior than the exterior of the bone. These changes may also be secondary effects of pyæmic infection from disease of other parts. The disease is usually arrested at the epiphyses, but it may spread to the adjacent joints. The joint-affection most commonly found in pyæmia is an extremely rapid suppuration. In no other kind of joint-inflammation does the destruction of the tissues involved so quickly take place. The cartilages may be found extensively ulcerated, and the joint filled with purulent fluid, within forty-eight hours of the first symptom of inflammation. At first the synovial membrane is swollen and vascular, and the joint distended with a slightly turbid fluid. This fluid usually quickly becomes purulent, and superficial erosions and softening of the cartilages occur, soon leading to extensive ulceration and irreparable destruction of the joint.

A less acute form of pyæmic arthritis is, however, not uncommon, in which several joints in succession become painful and distended, the effusion not becoming purulent, but subsiding after a variable period. 'Gonorrhœal rheumatism' is an example of this, and the joint-swellings occurring in women suffering from vaginal and uterine discharges are of the same kind. This affection of the joints frequently leads to adhesions, but occasionally runs on to suppuration. Scarlatinal pyæmia (in which the infection takes place from the ulcers in the throat), though often of a severe kind, is not infrequently attended with merely serous effusions into the joints, from which complete recovery takes place.

In some cases the inflammation, instead of attacking the synovial membrane, affects the fibrous structures around and outside the joints, or the sheaths of tendons, causing thickening and matting together of these tissues, and thus interfering with the mobility of the joint.

The *muscles* and *cellular tissue* are often invaded by pyæmic abscesses, and by inflammatory exudations and extravasations of blood. In the muscles the process commences in the cellular tissue between the fibres. Abscess in the inter-muscular septa and the subcutaneous cellular tissue is often the result of the more chronic forms of pyæmia.

The *skin* in many cases of pyæmia is found more or less jaundiced; petechiæ and sudamina are not uncommon; and sometimes a pustular eruption is seen. Patches of livid congestion also occur, some of which may have passed into gangrene in the centre or where subjected to pressure.

The morbid anatomy of *other organs* shows that secondary abscesses may occur in almost any situation; among the less rare may be mentioned the eye, the prostate gland, and the testicle.

SYMPTOMS.—A patient who has become the subject of pyæmia, often appears to be progressing quite favourably up to the moment when the disease attacks him; in other cases there may have been loss of appetite, depression, or restlessness, for a day or two, with perhaps some little elevation of temperature. The wound, if there be one, has probably assumed an unhealthy appearance; its surface may be dry, or the discharge may be thin and offensive, the healing process is arrested, and recent adhesions may give way. The attack, however, is usually sudden, and is almost invariably ushered in by a severe rigor, followed by sweating. The rigors are of variable duration and frequency, but are usually severe while they last; occasionally they recur with such regularity as to simulate ague. The patient at first may not feel particularly ill, but he rapidly becomes so. Pains in the limbs and general uneasiness occur; the pulse becomes weak and rapid; fever, of an intermittent type, commences, with its usual accompaniments of loss of appetite, restlessness, and thirst. The tongue becomes dry and brown; the bowels may be either constipated, or loose and irritable; and the skin and conjunctivæ may become jaundiced. If the infection be profound, the prostration is extreme; there are usually cough and dyspnœa; muttering delirium sets in early, and soon leads to unconsciousness and death. In such cases the blood-poisoning kills before there is time for the development of any secondary lesions.

In less acute cases local symptoms soon begin to appear. A day or two after the initial rigor, pain and swelling of one or more joints occur, or a subcutaneous abscess forms, or discolorations or pustules are seen on the skin. Cough, attended with rusty expectoration, is common; the respirations are rapid and shallow; there is pain in the chest; and perhaps dyspnœa or orthopnœa from pleuritic effusion. Meanwhile the depression increases; jaundice frequently comes on; and the face assumes a pinched and anxious expression. There is, moreover, often a peculiar sweet smell about the patient, somewhat resembling that of diabetic urine. The rigors mostly cease after the first few days, but the temperature usually maintains a remittent character. The skin shows a tendency to slough on very slight pressure, so that troublesome bedsores easily form; and patches of superficial gangrene sometimes

occur without any such provocation. Vomiting is not a symptom of frequent occurrence; and though there is usually no appetite, yet nourishment is often freely taken and digested. The cerebral symptoms are not usually severe, unless there be secondary lesions in the brain, but there is often a low form of delirium; and towards the end the patient usually becomes unconscious, and passes the evacuations unknowingly. Death may occur from general exhaustion; or from the severity of some local lesion, as, for example, from pericarditis, pleurisy, or cerebral abscess.

The duration of the disease is, in the majority of cases, from a week to ten days. It may, however, prove fatal in forty-eight hours; or, on the other hand, it may be prolonged for weeks or even years.

Pyæmia may commence at any stage of disease or injury; the most common period of invasion is during the second week.

Certain peculiarities must be noted concerning some forms of pyæmia, for which no satisfactory explanation can be given. For instance, in acute necrosis, pyæmic symptoms are frequently seen almost from the commencement of the disease, and yet these cases of pyæmia are sometimes of very long duration. Such cases, though severe, are among the least fatal; and when death does take place, abscesses are usually found in the heart and kidneys. The pyæmia arising from disease of the internal ear is especially prone to lead to pleurisy, which is often the prominent condition throughout. That variety of pyæmia associated with gonorrhœa and with scarlatina tends especially to affect the joints, and these are often the only parts invaded; but this joint-inflammation is very different from that which occurs in the course of other cases of pyæmia, for the effusion is generally slight, and does not usually become purulent. Such joint-affections are not uncommon after parturition.

Chronic Pyæmia.—There is, moreover, a chronic form of pyæmia which is not rare, and which is sometimes the prolonged termination of an acute attack, but more often is from its commencement characterised by the absence or slight degree of the constitutional disturbance. In this form of the disease ill-defined purulent collections occur, mostly in the connective tissue (subcutaneous, subperiosteal, or inter-muscular), which quickly reach a large size in a singularly quiet and painless manner, and with little or no febrile disturbance. Similarly quiet swellings or suppurations of joints may ensue; often there is an obvious phlebitis, and often also there are œdematous patches and puffy swellings, indicative of the blocking of less accessible veins. In some of these cases rigors occur, and profuse sweatings, with progressive emaciation, pallor, and weakness; in others the health and nutrition are but little affected, and the chief discomfort is due to the recurrent suppurations and their local effects. The disease may extend over months or years. Paget quotes a case lasting three years, and he points out that 'the election of a single tissue, and the observance of an uniform method of disease, in the secondary affections, are characteristic of chronic rather than of acute pyæmia. They are very marked in some of the cases that follow parturition, in which women suffer for many weeks with a succession of abscesses in the subcutaneous connective tissue of the limbs, and usually (after long suffering) recover completely. Such cases are also sometimes seen in men' (Paget, *Clinical Lectures and Essays*).

Occasionally, also, cases are seen of unusual duration in which there are severe constitutional symptoms throughout.

Diagnosis.—The chief difficulties in the diagnosis of pyæmia arise from the occasional prominence of some local symptom, which masks the general disease. Probably the most common mistake is to regard a case of acute necrosis, with early joint-symptoms and rigors, as one of rheumatism. Herein, however, there is an absence of the acid perspirations and the coated tongue of rheumatism; the rigors are more frequently repeated; and a careful examination will reveal mischief about the shaft of the bone as well as in the joint. When the chest-affection is severe, as in the pleurisy of children with disease of the internal ear, it may be looked upon as the primary disease; but a sudden attack of pleurisy occurring in anyone with otorrhœa, should at once give rise to a suspicion of pyæmia. The later stages and more chronic forms of the disease may present some resemblance to fever, but the history would usually give marked distinctions; and in the majority of cases the diagnosis is sufficiently easy at any period of the disease.

Prognosis.—The prognosis in all acute cases of pyæmia is very unfavourable. The great majority die, sooner or later; either early in the disease, from the general blood-poisoning, or subsequently, from the gravity or exhausting character of the secondary lesions. Yet some few do undoubtedly recover, and these are they in whom the viscera escape, and the disease expends itself upon the surface of the body, or runs a chronic course without involving vital organs. Puerperal pyæmia is less fatal than surgical.

Treatment.—The unsatisfactory results of the treatment, and the great mortality of pyæmia, are the strongest reasons for taking every possible precaution for its prevention. A consideration of the causes which predispose to, and favour the development of, the disease will suggest certain prophylactic measures. For instance, a patient who is suffering from an injury or operation should be supplied with an abundance of fresh air, and carefully guarded from the exhalations

of decaying organic matter. The most scrupulous cleanliness, both of the patient and his surroundings, should be observed. Overcrowding, and especially the accumulation of cases in which suppuration is going on, should be avoided. The careful drainage of wounds is of the greatest importance; for, whether germs be admitted or not, one obvious way of preventing decomposition in a wound is to take care that nothing is left therein to decompose. But by far the most important defence against pyæmia is the adoption of the antiseptic treatment of wounds. It is indisputable that since the general use of this method pyæmia has become a comparatively rare disease, and it is equally indisputable that this result depends upon the adoption of the principles of antiseptic surgery which have been so perseveringly taught and so carefully wrought by Sir Joseph Lister. Some statistics recently published furnish most striking evidence on this point. (See a paper by Messrs. Dent and Bull, analysing four hundred cases of amputation performed at St. George's Hospital, in which it is shown that the diminished mortality, as compared with previously published series from the same hospital, is due to the absence of pyæmia, resulting from the general use of the antiseptic system.—*Med.-Chir. Trans.*, vol. lxxiii.) Antiseptic dressings, besides their antagonism to the development of micro-organisms in the wound, have the great advantage of preventing putrefaction of the discharges, and the contamination of the surrounding atmosphere. Moreover, their use shields the patient from some of the accidental sources of infection which many of the former dressings made so easy; while at the same time the disturbance of the wound is greatly diminished (*see* ANTISEPTIC TREATMENT).

The integrity and functional activity of the chief excreting organs should be inquired into in all cases of operation or injury, so that the accumulation of effete material in the blood may be guarded against; and it should be remembered that the sudden change of condition that an operation or accident frequently involves, may in itself seriously interfere with the action of the bowels and kidneys.

When, however, pyæmia is developed, it must be admitted that treatment has over it but little control. The chief indication is to combat the extreme depression which is always present, and to endeavour so to support the patient that he may be able, if vital organs escape, to pass through the series of severe local affections that may be anticipated. Of drugs, tho most useful is quinine, which sometimes produces marked benefit; it should be given in full and frequently repeated doses.

The local affections must be treated on general principles. If there be a wound, tho dressings should be critically examined, and any defect in the antiseptic precautions sought for and remedied. If the discharges be foul, or there be any evidence of septic changes, the wound should be thoroughly exposed and cleansed with some powerful antiseptic. Drainage of the wound should be carefully attended to, and the possibility of the retention of discharges investigated. If there be no wound, the source of the pyæmic infection should be perseveringly looked for, and, if possible, removed, the frequency of its origin in disease of the middle ear, in discharges from the genital organs, and in osteo-myelitis, being especially borne in mind. The secondary abscesses should be opened early; and this is especially important with regard to the joints, from whence the pus should be evacuated directly we are sure of its existence. If symptoms of pyæmia occur in connexion with inflammation of a long bone, the question of amputation must be considered; and there are strong reasons for believing that by this measure the disease may sometimes be arrested. During the progress of the disease bedsores must be carefully guarded against, and the diet studiously adjusted to the daily needs; in fact, much will depend in this, as in the majority of serious disorders, upon careful nursing, judicious feeding, and the observance of every hygienic precaution.

J. WARRINGTON HAWARD.

PYELITIS (πύελος, a vessel).—SYNON.: Fr. *Pyélite*; Ger. *Nierenbeckenentzündung*. Inflammation of the pelvis of the kidney. *See* KIDNEYS, Diseases of: 22. Kidney, Inflammation of Pelvis of.

PYLEPHLEBITIS.—Inflammation of the branches of the portal vein, often associated with thrombosis. *See* PORTAL THROMBOSIS.

PYLORUS, Diseases of.—The muscular fibres of the stomach are disposed in three layers. Immediately below the peritoneum they are placed in a longitudinal direction; these are continuous with those of the œsophagus, and pass downwards over the organ, being continued to the duodenum; they are collected into bands of considerable thickness along the curvatures, especially the upper, and become stronger as they approach the pylorus. The middle layer surrounds the whole of tho stomach, but to the left of the cardiac orifice the fibres are thin, and are replaced by those that are oblique. At the pylorus they form a thick band or ring, acting as a sphincter to the opening into the duodenum. The oblique fibres are continuous with tho deep layer of tho muscular coat of the œsophagus. They arch over the fundus, but aro quite lost towards the opposite end of the organ. The muscular coats of the stomach are formed of involuntary or unstriped fibres,

being composed of elongated fibre-cells, which are united together by a sparing amount of connective tissue. The connective tissue is much thicker and stronger at the pylorus than at other parts of the organ, giving a great amount of firmness and strength to that region. The mucous membrane is also thicker, and the gastric tubes are wider than elsewhere. Most of these contain gastric cells, but are lined with conical epithelium to a greater depth than in the more actively secreting regions. Some anatomists have stated that in the human stomach, as in many of the lower animals, there are no pepsin-forming cells in this part; but in numerous cases the writer has been able to obtain an active artificial gastric juice from the mucous membrane covering it.

The pylorus participates in the diseases of the stomach, which are fully described under that heading (*see* STOMACH, Diseases of). As the outlet of that organ, however, the patency of the pylorus is of so great importance that its obstruction will be specially considered here.

Pylorus, Obstruction of.—An obstruction to the passage of the contents of the stomach into the duodenum is not infrequent, and may arise from very different pathological conditions. 1. The most common of these is the presence of a *cancerous* tumour at the pyloric end of the stomach. It usually surrounds the opening, and rarely spreads to the intestines. On microscopical examination the muscular fibres in the vicinity of such tumours are sometimes found to be hypertrophied, the contractile fibres being enlarged and increased in number. More generally the cells are atrophied, although to the naked eye the muscular bundles may seem to be enlarged; sometimes the contractile cells are faint and small; in other cases they are reduced to fibrous tissue, and no trace of the original structure can be discovered. This condition of the muscular tissue furnishes us with an explanation of the fact, that there is often great obstruction to the passage of the gastric contents into the duodenum where the pyloric opening seems only partially constricted, and it is to this loss of muscular contractility, and not to the mere narrowing of the opening, that we must look in order to understand how in many cases the stomach becomes dilated from its incapacity to discharge its contents. 2. The pylorus is sometimes narrowed by *fibroid thickening* of the submucous tissue. This morbid change may be confined to the opening only, or it may extend some distance from the part chiefly affected, producing a hard, leathery condition of the coats. The same effect, although to a less degree, is produced by an obstruction of this kind, as by cancer. The muscular bundles become hypertrophied, their contraction being embarrassed by the tough, fibrous tissue that surrounds and separates them. 3. The pyloric opening may be obstructed by an *ulcer*. This may arise either by its cicatrix producing a contraction, which leaves only a small opening through which the food has to find its way; or, on the other hand, the muscular coat may have been destroyed by the ulceration, and the stomach may, in this way, be unable to force onwards its contents. 4. The pylorus or the duodenum may be constricted by the pressure of a *tumour*. Cases have occurred where a cancerous gall-bladder has compressed these parts, but more generally the pressure is caused by glands enlarged by malignant disease. In a case which came under the notice of the writer, the opening was constricted by enlarged scrofulous glands occurring in a man affected with phthisis. 5. *Adhesions* may form between the duodenum or pylorus and the neighbouring parts, and in this way they may produce a difficulty in the passage of the food from the stomach. A curious case fell under the writer's notice in which a man received a severe blow in the abdomen, which was followed by symptoms of obstructed pylorus. On *post-mortem* examination a portion of the upper part of the small intestine was found to be bent upon itself by the exudation of lymph into the mesentery close to its edge.

EFFECTS.—The effect of any considerable obstruction at the pyloric opening is to produce a greater or less degree of dilatation of the stomach. The most prominent symptom is vomiting, occurring at irregular intervals, and usually several hours after taking food. Along with this we find heartburn, and other signs of indigestion; and a gradual loss of flesh and strength. The treatment must be directed to these effects and symptoms. *See* STOMACH, Diseases of: 7. Dilatation.

SAMUEL FENWICK.

PYONEPHRITIS.—Inflammation of the kidney, leading to the formation of abscess. *See* KIDNEYS, Diseases of: 28. Kidney, Suppurative Inflammation of.

PYOPNEUMOTHORAX.—A morbid condition of the pleural cavity, in which it contains both pus and gas. *See* PLEURA, Diseases of.

PYRENEES. — *See* BAGNÈRES-DE-BIGORRE; EAUX-BONNES; EAUX-CHAUDES; and PAU; and CLIMATE, Treatment of Disease by.

PYREXIA (πῦρ, fire; and ἔχω, I have). This word is sometimes employed as a synonym for fever; but it is more properly applied to the elevation of the body-heat which is one of the phenomena of fever. *See* FEVER; and TEMPERATURE.

PYRMONT, in Germany. — Iron waters and salt waters. *See* MINERAL WATERS.

PYROMANIA.—A name which has been given to insanity when the patient manifests a propensity to incendiarism. Its claim to be regarded as a special form of insanity has not been established. *See* INSANITY, Varieties of.

PYROSIS (πυρόω, I burn).—SYNON.: Water-brash; Fr. *Pyrosis*; Ger. *Sodbrennen.*

DESCRIPTION.—Patients affected with water-brash experience a severe spasmodic pain at the epigastrium, which is often attended with a feeling of constriction; and after the lapse of a few minutes relief is afforded by the rejection of a quantity of watery fluid. The fluid is usually tasteless, without any odour, and seldom amounts to more than two or three ounces. Microscopically, it presents numerous epithelial scales from the mouth, and the writer has also found in it some gastric cells. It is neutral to test-paper, is not albuminous, and in one case in which he carefully examined it, it gave a dense precipitate with baryta, and a bulky precipitate with nitrate of silver, soluble in nitric acid. Frerichs remarked that the fluid contains sulphocyanuret of potassium, and therefore believed it was only saliva. But it is evident that it can scarcely be possible to obtain it entirely free from the salivary secretion, and therefore no great weight can be allowed to the observation. However, in some cases the fluid rejected is evidently only saliva. Water-brash is not necessarily connected with structural disease of the stomach, for the majority of those who suffer from it recover perfectly. In some persons affected with disease of the pylorus, the rejection of a tasteless fluid takes place, but this is not necessarily accompanied nor preceded by pain.

ÆTIOLOGY AND PATHOLOGY.—Water-brash seldom occurs before puberty; it affects females more frequently than males; and chiefly presents itself in persons of middle age. It is more prevalent in some countries than in others; and is most general amongst those who subsist on food of a coarse and indigestible kind. Much difference of opinion has been expressed as to the source of the fluid which constitutes water-brash. It has been referred to the œsophagus, stomach, duodenum, and pancreas. The pancreas seems unlikely to be the organ from which it comes, for the fluid is unmixed with bile, and we should imagine a more violent effort would be required to reject it from a part so distant from the mouth. Again, the œsophagus is very intolerant of any collection of liquid in it, and it would only be by a spasmodic closure of the cardiac orifice that such an accumulation could occur in this tube. As regards the stomach, it seems improbable that the larger and more active end of this organ should be the source of the liquid, for any irritation would produce an acid, not a tasteless, fluid. At the pyloric end, however, there is a mass of tubes, lined chiefly with conical epithelium, the office of which is to secrete mucus; and as the only structural change that has been found along with water-brash is thickening at the pylorus, we may reasonably conclude that this is the part whence the fluid is ordinarily derived.

TREATMENT.—All sources of gastric irritation should be removed, such as every form of insoluble or irritating food. Astringents, with or without opium, are the most efficacious remedies. They should be given in the intervals between digestion, so that they may act directly on the mucous membrane. Lime-water, bismuth, zinc, or other mineral astringents, or vegetable astringents, such as kino, krameria, logwood, or tannic acid, may be preferred; but, on the whole, the writer has found the oxide and nitrate of silver the most efficacious. Unless there be some objection to it, opium may be combined with the astringents, as it both lessens the pain and seems to restrain undue secretion; or mercurial alteratives may be given, as their use is often attended with the best results.

SAMUEL FENWICK.

PYSTJAU, in Hungary.—Thermal sulphur waters. *See* MINERAL WATERS.

PYTHOGENIC FEVER (πύθω, I rot; and γεννάω, I beget).—A synonym for typhoid fever. *See* TYPHOID FEVER.

PYURIA (πύον, pus; and οὖρον, the urine).—A name for a condition of the urine in which it contains pus. *See* URINE, Morbid Conditions of.

Q

QUARANTINE (Ital. *quaranta*, forty). SYNON.: Fr. *Quarantaine*; Ger. *Quarantäne.*

DEFINITION.—The enforced isolation of individuals and certain objects coming, whether by sea or by land, from a place where dangerous communicable disease is presumably or actually present, with a view of limiting the spread of the malady. The objects liable to quarantine include—on the assumption of their being apt to carry the contagion or

infection of the disease—the luggage and personal effects of the individuals isolated, certain articles of merchandise, and ships; and, in land quarantine, carriages and other vehicles. Sometimes entire communities and districts are subjected to quarantine.

History.—According to systematic writers, quarantine had its origin in the fourteenth century, when the principle of isolation, applied from a much earlier period to leprosy (*mal de St. Lazare*), began to be extended to pestilential diseases; and leper hospitals (*lazarets*), then falling into disuse from the decline of the disease, were converted to (as we should now say) quarantine uses. To this day quarantine establishments retain the name significant of their original purpose—namely, *lazarets*. Fodéré suggests that the period of forty days during which it was customary formerly to enforce isolation, and from which the designation *quarantine* is derived, had its source in the teaching of Hippocrates, who, according to Pythagoras, attributed a special virtue for the completion of many things to that period of time. The methodical establishment of quarantine dates from the sixteenth century, when the earliest doctrines of contagion, in the original acceptation of the term, were also formulated. These doctrines, fantastic though in many respects they now appear, still largely adhere to the practice of quarantine. Plague, as we now understand the word (*see* Plague), was the disease against which quarantine was chiefly, indeed almost wholly, levelled, until the beginning of the present century; and the system is so imbued with the notions formerly held as to this malady that it has been found impossible to disembarrass it from them, in endeavouring to apply quarantine to other forms of disease. It is noteworthy that, as plague declined in Western Europe, and the area of its prevalence in the Levant became more and more restricted, the system of quarantine appears to have become more elaborate. Speculative notions, uncontrolled by experience, and applied to the system, caused it to be overlaid with grotesque and puerile details. Notwithstanding, however, these drawbacks, the arbitrariness of the system, and the losses it inflicted upon commerce, without obvious proportionate gains, the advantages offered by quarantine in the protection of a country from pestilential disease appeared theoretically to be so great, that neither administrative follies, nor the lessons as to its fallacies derived from experience, nor its general futilities, availed to bring about the substitution of a more rational system of protection.

Quarantine remained substantially unmodified from the termination of the last century to the fifth decade of the present, since which time it has undergone great changes, with a view of rendering the practice more consistent with existing knowledge of the diseases to which it is applied, and of freeing it from the more preposterous detentions and practices which had become attached to it.

Quarantine Acts.—In the present article we shall deal only with quarantine as it exists in this country. In Great Britain and Ireland, quarantine, which is carried out under an Act of Parliament passed in the reign of George IV. (6 Geo. IV. c. 78), has no longer a medical signification. It is practised, and that only to a limited extent, solely with a view of relieving our maritime commerce from disabilities which would else be imposed upon it by other countries, in which quarantine is regarded as an essential part of the public-health administration. The regulation of quarantine is not a function of the department of the Government which is concerned with the sanitary administration of the kingdom (the Local Government Board), but of the Privy Council, aided by the Board of Trade, the subject being dealt with as an international commercial question. In what follows an authoritative official memorandum of the late Dr. E. C. Seaton (formerly medical officer of the Local Government Board) on the subject is closely adhered to.

The Quarantine Act provides for land quarantine and the quarantine of inland waters, as well as for maritime quarantine—internal and external quarantine, so to speak. It does not appear that internal quarantine has ever been enforced in this country since the Act was passed. Maritime quarantine alone has been practised, and this has been applied to three diseases only, all of them infectious diseases of foreign origin, namely, plague, cholera, and yellow fever. Of plague there has been no question in English ports for the last thirty years or thereabouts, except a slight alarm in 1879, consequent upon an outbreak in south-eastern Russia, in the province of Astrakhan. Against cholera, quarantine has not been enforced since 1858, its futility as a precautionary measure in this country having then been abundantly manifested. Yellow fever is the sole disease at present subjected to it in our ports, and this, as already stated, not from the medical necessity, but from the commercial exigency of the case. The only quarantine establishment now remaining in England—that at the Motherbank—is maintained in respect of this disease. Infectious diseases habitually current in this country, such as small-pox and scarlet fever, notwithstanding that the phraseology of the Quarantine Act covers *any* 'infectious disease or distemper,' have always been in practice exempt from quarantine, and dealt with under the general sanitary law of the kingdom. It appears to have been recognised that measures, primarily designed to prevent the introduction into the

country of diseases only coming to us from abroad, and which involved international considerations, would be misapplied if used for the purpose of preventing the importation of diseases ordinarily existing here, the limitation of which, and not the exclusion, could alone be in question.

In reference to cholera, foreign countries have, during recent years, shown a readiness to modify the requirements of quarantine, and substitute shorter periods of detention for those formerly insisted on. Conferences between representatives of the Powers have been held at Paris in 1854, Constantinople in 1866, Vienna in 1874, Rome in 1885, Venice in 1892 (the conclusions of which were subsequently modified at Paris), and Dresden in 1893, when Great Britain was represented by Mr. Strachey, the resident Minister at Dresden, Dr. Thorne Thorne, C.B., Medical Officer of the Local Government Board, and Mr. H. Farnall, C.M.G., of the Foreign Office. Inasmuch as the conclusions of this last conference have been accepted by the English Government, it will be convenient to give a brief account of their nature.

I. *Notification to Foreign Governments.*—A cholera centre [1] is to be notified to all the Governments signing this agreement. Isolated cases are not necessarily to be notified. Communications concerning progress of disease are to be made at least once a week.

II. *Circumstances under which Districts are to be deemed Infected.*—A district is to be considered infected when the existence of a cholera-centre has been officially stated; no longer infected when no deaths or fresh cases have occurred within five days, and the measures for necessary disinfection have been taken.

[The word 'district' is applied to any part of a country placed under a well-defined administration.]

III. *Limitation to Infected Districts of Preventive Measures.*—Measures for limiting the spread of the epidemic are only to apply to products of the infected districts, and not then if the products have left the country five days before the outbreak began.

IV. *Merchandise or Dangerous Articles considered from the point of view of* (1) *Prohibition of Importation and Transit, and* (2) *of Disinfection.*

1. The only things to be forbidden are: (*a*) body-linen, clothes in use, bedding (except when considered as luggage or when moving from one house to another, when they are to be specially dealt with); (*b*) rags and drills, but the following are not to be prohibited: rags compressed by hydraulic power, which are forwarded as wholesale merchandise and labelled with name of the place of destination, &c.; and clean clippings coming direct from spinning, weaving, making up, or bleaching establishments; artificial wool, and fresh paper shavings. Goods are not to be detained in quarantine on the frontiers of countries.

2. Disinfection of baggage is to be obligatory in respect of such things as clothes, dirty linen, &c., coming from an infected district, if the local sanitary authority consider them contaminated. Merchandise is to be disinfected so as to damage as little as possible; each State is to arrange the method of disinfection. Letters or printed matter are not to be disinfected.

V. *Measures at Land Frontiers—Railways, Travellers.*—Infected carriages are not to be retained at frontier towns—if soiled, they are to be detached for disinfection wherever possible. Land quarantine is no longer to be established. Only persons suffering from cholera and those attacked with a choleriform disease are to be detained. The officials of the railway are to see if all travellers are well—if ill, a medical man is to be called in. Inspection is to be made, if possible, at the Custom-house stations so as to hinder travellers as little as possible. On arrival at destination, travellers coming from infected districts are to be subject to five days' observation dating from the time of their departure from such districts. This, of course, does not apply in the case of Great Britain, which has no land frontier.

Special measures may have to be taken with regard to bohemians, vagabonds, emigrants, and persons travelling in parties.

VI. *Regulation of Frontier Traffic.*—Frontier traffic arrangements are to be left to special measures to be taken by the neighbouring (adjoining) countries.

VII. *Waterways.*—The arrangements for regulating traffic are to be left to the States on river banks. Those regulations in force in Germany in 1892 are recommended.

VIII. *Measures to be taken at Ports.*—A ship is to be considered *infected* which has cholera on board, or if it has had fresh cases of cholera during the preceding seven days; to be considered as *suspected* where there have been cases on board though not during the last seven days; to be considered as *healthy*, though coming from an infected port, if having had neither case of cholera nor death from cholera on board before the departure, during the voyage, or since arriving.

Infected ships are to submit to the following:—

(1) The sick are to be disembarked and isolated. (2) The others are to disembark and remain under observation during a period not exceeding five days. [The signature of

[1] The term actually used is *foyer*, and is thus referred to by the *Lancet* of July 15, 1893, p. 152: 'Practically the use of the term *foyer* means that if there are isolated cases of cholera the French Government will not notify; but if cases are grouped together and form a sort of kernel—a centre, a focus, radiating, scattering around the germs of disease—then the French Government will notify.'

Great Britain to the Dresden Convention was conditional that for the purposes of England the 'observation' should, both for infected and suspected ships, be in the homes of the persons under observation instead of in any specially provided place.] (3) Dirty linen and clothes, &c., belonging to passengers are to be disinfected, if deemed contaminated by the sanitary authority, as well as the ship or part of ship infected.

Suspected ships are to submit to—

(1) Medical inspection, (2) disinfection, (3) removal of bilge-water after being disinfected, and substitution of good drinking-water in place of that stored on board.

It is recommended that passengers should be under observation not more than five days from the date of arrival, and that the disembarkation of the crew should be delayed.

Healthy vessels are to be allowed free pratique. It is, however, permissible that the authority of the port may in the case of healthy vessels adopt the same measures as in the case of suspected vessels, except that the period of observation (five days) should date from the time of departure of the vessel instead of the date of arrival.

The authority of the port is to take into consideration, before ordering these measures to be adopted, the presence of a doctor and of a disinfecting-stove on board the vessel. Special precautions are to be taken on vessels crowded with emigrants, and insanitary vessels. Goods arriving by sea can only be treated similarly to those arriving by land. All ships refusing to submit to the port arrangements are free to put out to sea. They may only unload after the necessary precautions have been taken—(1) isolation; (2) removal of bilge-water; (3) substitution of good water. No passengers are to disembark unless willing to submit to the port regulations. Every country should provide at least one port on each of its coasts with the organisation and apparatus for receiving ships whatever their sanitary state. Coasting vessels are to be subject to special regulations, to be arranged between the countries interested.

Special measures are to be taken with regard to vessels coming from an infected port and going up the Danube. Until the town of Soulina is provided with a good water-supply, all boats going up the river are to be subjected to rigorous hygienic measures. Overcrowding of passengers is to be strictly forbidden.

It is interesting to observe that, while foreign countries are thus agreeing to regulations which approximate in some degree to those which are in force in Great Britain, British colonies, having independent control in respect of this subject, maintain a more rigid system of quarantine, and do not limit its application to diseases which in this country are subject to the quarantine law. Thus Malta, Gibraltar, and Cyprus, as well as the more distant colonies, adhere to the old quarantine system; and, indeed, the West Indian colonies have during the present year (1893) enacted a quarantine law, to which reference may be made as illustrative of the action of colonies in this respect.

The measures which have, in England, been substituted for quarantine against cholera—the only foreign epidemic which at present much concerns the health of this country—consist in a 'system of medical inspection,' the details of which are set forth in the Orders of the Local Government Board, dated the 28th of August, 1890, the 29th and 31st of August, 1892, and the 6th of September, 1892. This plan differs from 'quarantine' in the following essential respects:—

(*a*) It affects only (1) such ships as have been ascertained to be, or as there is reasonable ground to suspect of being, *infected* with cholera or choleraic diarrhœa; no vessel being deemed infected unless there has been actual occurrence of cholera or of choleraic diarrhœa on board in the course of the voyage. (2) Ships not infected with cholera, but having passengers on board who are in a filthy or otherwise unwholesome condition. (3) Ships coming from a place infected with cholera.

(*b*) It provides for the detention of the vessel so long as is necessary for the requirements of a medical inspection; for dealing with the sick (if any) in the manner it prescribes; and for carrying out the processes of disinfection.

Any person suffering from cholera must be removed, if his condition admit of it, to some hospital, or other suitable place for that purpose appointed by the sanitary authority; and no person so removed may leave such hospital or place until the medical officer of health has certified that he is free from the disease. If any person suffering from cholera cannot be removed, the ship must remain subject to the control of the medical officer of health. If any person is certified by the medical officer of health to be suffering from any illness which he suspects to be cholera, such person may be removed to some hospital, or other suitable place provided by the sanitary authority, or be detained on board the ship for any period not exceeding two days.

(*c*) It subjects the healthy on board to detention only for such length of time as admits of their state of health being determined by medical examination, or until they have satisfied the medical officer of health as to their names, places of destination, and addresses at such places. The name and address of any such person is to be forthwith given by the medical officer of health to the clerk to the sanitary authority, who is required to transmit the same to the local

authority of the district in which the place of destination of such person is situate.

In the case of ships infected with cholera, or which have come from a place infected with cholera, the medical officer of health may direct the bilge-water to be pumped out before such ship enters any dock or basin; and, on the sanitary authority providing a proper supply of water for drinking and cooking purposes for persons on board the ship, he may direct all casks or tanks on board the ship containing water for the use of such persons to be emptied; and the master is required to cause these directions to be carried into effect.

In addition to the above Orders, others have been issued from time to time regulating the admission of rags from foreign countries infected with cholera.

The measures for dealing with the sick under the Orders of the Local Government Board, are but an adaptation to a particular exigency of the principles of sanitary administration with regard to infectious diseases, which are in force under the general sanitary law of the kingdom.

But though quarantine has no present practical existence in this country, except as regards yellow fever, and all other infectious diseases are dealt with either under the general sanitary law of the country, or such modification of it as has been just described with regard to cholera, the machinery which is maintained under the Quarantine Acts, for obtaining information as to the existence of infectious diseases on board foreign-coming ships, is made available for dealing with all diseases of that kind, whether they are quarantinable or not. The quarantine questions, as they are termed, which it is the duty of the Customs to put to the masters of all such vessels, embrace all infectious diseases; and, in the event of any such disease not of a quarantinable kind being found to exist on board, or to have existed in the course of the voyage, the quarantine officer is required to detain the vessel, and to forward the information with the least practicable delay to the sanitary authority of the port. In regard to cholera, moreover, both the Customs and the sanitary authority have certain powers of detaining the vessel specified in the Orders of the Local Government Board above referred to.

The provisions under Articles 12, 13, and 14 of the Order of the Local Government Board of 1890, as to the mode of dealing with persons who may arrive from abroad infected with cholera, will be better understood if a succinct statement be made of the ordinary provisions of the aw with regard to infectious diseases in England. The authorities which have to administer that law, as now existing under the Public Health Act, 1875, are the urban, rural, and port sanitary authorities of the districts into which the whole kingdom is divided. These authorities are empowered—

(*a*) To provide hospitals or temporary places for the reception of the sick (section 131);

(*b*) Where a hospital or place for such purpose is provided, to remove thither by order of any justice, on a certificate signed by a legally qualified medical practitioner, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, *or on board any ship or vessel* (section 124);

(*c*) To make regulations (to be approved by the Local Government Board) for removing to any hospital, to which the local authority is entitled to remove patients, and for keeping in such hospital so long as may be necessary, any persons brought within their district by any ship or boat who are infected with a dangerous infectious disorder (section 125);

(*d*) To provide and maintain a carriage or carriages suitable for the conveyance of persons suffering under any infectious disorder (section 123);

(*e*) To cleanse and disinfect infected premises, and articles therein; to destroy any bedding, clothing, or other articles which have been exposed to infection from dangerous infectious disorder, giving compensation for the same; and to provide all necessary means for the disinfection of infected things (sections 120, 121, 122);

(*f*) To take proceedings against (1) any person who, while suffering from any dangerous infectious disorder, wilfully exposes himself, without proper precautions against spreading the said disorder, in any street, public place, shop, inn, or public conveyance, or enters into any public conveyance without previously notifying to the owner, conductor, or driver thereof that he is so suffering; or (2) any person who, being in charge of any person so suffering, so exposes such sufferer; or (3) any person who gives, lends, sells, transmits, or exposes without previous disinfection, any bedding, clothing, rags, or other things which have been exposed to infection from any such disorder; or (4) any owner or driver of a public conveyance who shall not have immediately provided for the disinfection of such conveyance, after it has to his knowledge conveyed any person suffering from a dangerous infectious disorder; or (5) the owner of any house, in which any person has been suffering from any dangerous infectious disorder, who shall knowingly let it or part of it for hire, without having previously disinfected it, and all articles therein liable to retain infection, to the satisfaction of a legally qualified medical man; or (6) any person who, showing for the purpose of letting for hire any house or part of a house,

shall make false statements as to the existence of infectious disease therein, or within six weeks previously (the several acts here enumerated constituting offences liable to penalty under the Public Health Act, ss. 126, 128, 129);

(*g*) To provide mortuaries, and to obtain the removal thither, by order of a justice, of the body of anyone who has died of any infectious disease, which is retained in a room where persons live or sleep, or of any dead body in such a state as to endanger the health of the inmates of the house or room in which it is retained (sections 141, 142);

(*h*) To make inspection of their district, with a view to ascertain what nuisances exist calling for abatement under the powers of the Act, and to enforce the provisions of this Act in order to abate the same (section 92): a provision which extends to shipping—any ship or vessel lying in any river, harbour, or other water, within the district of a sanitary authority, being subject to the jurisdiction of that authority, in the same manner as if it were a *house* within such district;

(*i*) Finally, to appoint a medical officer of health, inspector of nuisances, or several of those officers, according to the needs of the district, and other requisite officers to aid them in the proper and efficient execution of the Act (sections 189, 190). The duties of the medical officer of health and of the inspector of nuisances, when (as is the case in the greater number of instances) the assent of the Local Government Board has to be given to their appointment, are set forth in Orders of the Board dated March 1880.

Beyond the powers conferred upon Sanitary Authorities by the Public Health Act, 1875, other powers of considerable importance in relation to the subject under discussion can be obtained by Sanitary Authorities adopting the provisions of the Notification of Infectious Diseases Act, 1889, and the Infectious Disease (Prevention) Act of 1890.

Under the former Act, the authority can require every medical practitioner attending or called in to visit a patient to give notice to the Medical Officer of Health of the district if the patient be suffering from 'small-pox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names—typhus, typhoid, enteric, relapsing, continued, or puerperal,' as well as any other infectious disease which the authority by special resolution may require. The duty of giving notice to the Sanitary Authority also devolves upon the head of the family to which the patient belongs, and in his default the nearest relative of the patient present in the building or being in attendance on the patient, and in default of any such person, the occupier of the building.

Under the latter Act, powers can be obtained for—

(*a*) Prohibiting the supply within a district of milk from a dairy believed to be productive of infectious disease.

(*b*) Prohibiting any person ceasing to occupy a house, room, or part of a house, which has been occupied by a person suffering from infectious disease, without having such house, room, or part of a house, and all articles therein likely to retain infection, disinfected to the satisfaction of a registered medical practitioner, or without giving notice of the previous existence of such infectious disease to the owner, and prohibiting any such person giving any false answer to the owner or to any person negotiating for the hire of such house, room, or part of a house, as to the fact of there having within six weeks previously been therein any person suffering from any infectious disease.

(*c*) Prohibiting any person from retaining without the sanction in writing of the Medical Officer of Health or a registered medical practitioner, elsewhere than in a mortuary or in a room not used at the time as a dwelling-place, sleeping, or work room, for more than forty-eight hours, the body of any person who has died of any infectious disease.

(*d*) Prohibiting any person from removing from any hospital or place of temporary accommodation for the sick, except for the purpose of burial, the body of any person who has died from infectious disease, if the Medical Officer of Health or any other registered medical practitioner has certified he is of opinion that it is desirable, in order to prevent the risk of communicating any infectious disease, or of spreading infection, that such body should not be removed from such hospital or place except for the purpose of being forthwith buried. Under such circumstances the body when removed must be taken directly to a place of burial or to a mortuary.

(*e*) Empowering a justice of the peace on the application of the Medical Officer of Health to order the removal to a mortuary, and to be buried, the body of any person who has died of infectious disease, and which has remained for more than forty-eight hours without the sanction of the Medical Officer of Health or a registered medical practitioner in a room used at the time as a dwelling-place, sleeping-place, or work-room.

(*f*) Requiring any person who desires to remove in a public conveyance, other than a hearse, the body of any person who has died from infectious disease, to give notice to the owner or driver, and requiring such owner or driver to disinfect the conveyance.

(*g*) Authorising a justice of the peace to make an order directing the detention in a hospital, at the cost of the authorities, of any person suffering from infectious disease, and

who would not on leaving such hospital be provided with lodging or accommodation in which proper precautions could be taken to prevent the spreading of the disorder of such person.

(*h*) Prohibiting the casting into any ash-pit, ash-tub, or other receptacle for the deposit of refuse matter, any infectious rubbish without previous disinfection.

(*i*) Empowering the local authority to provide, free of charge, temporary shelter or house accommodation, with any necessary attendants, for the members of any family in which any infectious disease has appeared, who have been compelled to leave their dwelling for the purpose of enabling such dwelling to be disinfected by such authority.

The general powers above enumerated, if exercised duly and with reasonable diligence, are held sufficient to provide for the exigencies which may arise in our ports from the introduction of infectious diseases by ships, whether the disease be current in this country or be of foreign origin not naturalised here; but in the case of a non-naturalised disease, such as cholera, certain additional securities are taken by the Orders of the Local Government Board previously referred to. The general powers, moreover, which are available against the importation of infectious diseases by shipping, are available also, and have on occasions been used, against their exportation in like way to other places.

Harry Leach. Shirley Murphy.

QUARTAN (*quartus*, the fourth).—A form of ague, in which the paroxysm returns after an intermission of two days. *See* Intermittent Fever.

QUEENSTOWN, in South of Ireland.—Mild, not relaxing, winter climate. Southern exposure, with shelter. Mean winter temperature 44·1° F. *See* Climate, Treatment of Disease by.

QUINISM.—Synon.: Cinchonism; Fr. *Quinisme*; Ger. *Cinchonismus.*

Definition.—A group of symptoms, chiefly connected with the nervous system, produced by the presence of quinine in the system.

Anatomical Characters.—In the rare cases in man in which death has been due to quinism, *post-mortem* examination has revealed only the appearances which are common to every case of gradual suspension of respiration, namely, accumulation of dark blood in the internal veins. The same has been found in experiments on animals.

Symptoms.—Large doses of quinine prove fatal by paralysing, first, the brain and respiratory centre; secondly, the heart. Smaller doses may produce various symptoms on the different organs.

On the whole, quinine does not disturb *digestion*; on the contrary, of all alkaloids tested on this point, of course in the shape of a readily soluble salt, quinine, when given in small doses, alone promotes digestion. Undoubtedly it may often cause vomiting, but for this there may be three reasons—the sickening bitter taste, the selection of a salt not easily soluble when there is a deficiency of normal hydrochloric acid in the stomach, and the unusual influence of quinine on the brain. The first two reasons can easily be avoided, if the physician knows them; and also the third, if too large doses are not given at once to susceptible patients. The intolerance of the brain soon ceases. It is advisable to tell the patient that vomiting may perhaps follow on the first dose, but that that must not prevent the second being taken—then only a little nausea will ensue, and after the third dose neither. In whooping-cough the first effect of quinine is even to stop vomiting, and improvement of other symptoms follows.

The local irritation of the stomach often depends on the use of the sulphate, whilst the hydrochlorate is easily borne. The sulphate is soluble in about 800 parts of distilled water, the hydrochlorate in about 30 parts. Free hydrochloric acid renders them both equally soluble; but when this acid is deficient in the gastric secretion, as is the case in most fevers, the water alone may sufficiently dissolve the hydrochlorate, but not so the sulphate. It remains longer than it should as a foreign body in the stomach, and causes irritation. It is an old mistake to prescribe the sulphate, merely because it happened to be the quinine salt first introduced. The hydrochlorate not only irritates the stomach less, but contains also a greater percentage of the base than the sulphate does. These advantages compensate for a somewhat higher price.

The *toxic* effects of quinine, so often mentioned, are the result of large doses. They manifest themselves as deafness, noises in the ears—humming, or resembling the roar of a distant waterfall, the ringing of bells, or the striking of a clock; sickness, heaviness in the limbs, retching, vomiting, and inclination to sleep. Quinine intoxication can, of course, become dangerous, should the dose have been too large. It shows itself as paralysis of the nerve-centres, and later as paralysis of the heart. Irritation no longer causes the slightest contraction; one could imagine that the heart was poisoned by digitalis. The writer has at least thus observed it in animals. The skin is pale and cold, and the temperature of the blood, measured in the rectum, may show an enormous depression.

A man of forty-five, who suffered from constipation, took by mistake three drachms of sulphate of quinine, instead of the same quantity of cream of tartar, at a single dose. In an hour, pains came on in the head and stomach, giddiness, and general weak-

ness, followed by unconsciousness. The face was pale; the lips blue and cold, as also the limbs; the pulse was still regular, but slow and almost imperceptible; the respiration languid and superficial; the pupils much dilated; vision and hearing almost gone, even after return of consciousness. The medical attendant, who was called after eight hours, wrapped up the whole body in hot towels, and used frictions of the skin and internal stimulants. Improvement ensued after a few hours, and increased steadily during the following days; but even on the fifth day the patient was unable to leave his bed for more than half an hour. The general weakness and that of sight and hearing improved, but did not disappear completely for a long time.

In a French military hospital (1885) a soldier got by mistake a 5 per cent. solution of sulphate of quinine, instead of a similar solution of sulphate of magnesium, equal to twelve grammes, viz. two-fifths of an ounce, of the former. When he complained of the disagreeable bitter taste and of the humming in the ears, the attendant thought proper to swallow the same quantity. Both were taken very ill after less than half an hour; both suffered from great general apathy and weakness of the heart. The soldier recovered, because a large portion of the solution of quinine was rejected by spontaneous vomiting; the attendant died before the lapse of four hours, with the symptoms of paralysis of the nervous centres.

Experiments on rabbits and dogs have proved to the writer that, under the influence of large doses of quinine, the respiration is first paralysed, and that life can be preserved at this stage by artificial respiration. Then the heart becomes paralysed by direct influence of the quinine on it, and death ensues.

Altogether, the physician should ask himself, in every case where he considers large doses of quinine desirable, whether an existing or threatening weakness of the respiration or the circulation might prove an objection to the prescription. Speedy death has been observed in typhoid fever in patients or convalescents after about twenty grains of quinine; and even less may prove dangerous. In such cases one should not go higher than ten grains, and at the same time give good wine in moderate doses and frequently.

In connexion with the influence of quinine on the heart, it must be mentioned here that its action in *small* doses consists of a slight irritation of the organ, probably of its substance. The vagus has no connexion with the effect; it requires strong doses to depress this nerve a little, and infinitely less than atropine does.

The disorders of *hearing* caused by quinine generally last only for some hours or a few days; but severe cases are also reported. A man of thirty-seven took 20 grains of hydrochlorate of quinine in one dose for ague. The ague left him, but he almost immediately got loud noises in the ears, pain in the left ear, heaviness of the head, fits of giddiness, and intense deafness. The ticking of a watch and the humming of a diapason, were no longer heard when they were pressed to the skull. Eighty grains of salicylate of sodium, taken within five hours (one must ask for what purpose), aggravated all the symptoms. Aural treatment during several months produced but partial improvement. Hearing was slightly better, but still bad.

Investigations on the hearing of healthy men have yielded some interesting results. The temperature of the outer ear, after a dose of 17 grains of hydrochlorate of quinine, sank 0·56° C. on an average in twelve experiments within two or two and a half hours. The external meatus and the tympanum were not hyperæmic—on the contrary, they were pale—when the effect of the quinine was at its height. It does not follow that this must always be the case. Some people may get inflammation of the tympanic cavity; others, again, inflammation of the skin, as will be described presently. Inflammatory extravasations were produced artificially in the *canalis cochleæ spiralis* and other parts of the inner ear in a cat, by dosing it with quinine. The writer knows from his own observation that this animal is certainly very sensitive to quinine. It is only in exceptional instances that quinine produces lasting bad effect on the hearing of human beings.

Disturbances of *vision* after large doses of quinine have often been observed. They are caused by direct paralysis of the optic nerve, not by dimming of the refractive media. A. von Graefe, the founder of modern ophthalmology, has described two cases, both malarial patients. In one case 360 grains had been taken during several weeks; in the other case 500 grains. In the first case weakness of sight ensued; in the second case blindness. Both cases lasted several months. Improvement began of itself, and was apparently aided by artificial bleeding from the temples. Many similar cases have since been reported.

The following case is more recent: A woman of thirty-five had aborted, with symptoms of septic endometritis. Cold baths and quinine—80 grains in the course of thirty hours—were employed to control the fever. An eclamptic fit ensued, and immediately afterwards complete loss of hearing and sight. The urine was free from albumen; the pupils were much dilated and fixed, the refractive media clear, the retina almost bloodless and perfectly insensible to strong light. Consciousness returned a day after the attack; hearing within the first few days. The blindness of the peripheral parts of the

retina remained permanently; that of the central parts disappeared slowly within six months. Colour-blindness, which had been total when the sensibility to light returned, persisted partly.

It is evident, however, from the reports of cases, that disturbances of vision in patients treated with quinine may often be caused to a great extent by the illness itself, and are then incorrectly attributed to the remedy.

Transient *affections of the skin* after the ingestion of quinine are especially frequent. They present themselves chiefly as eczema, roseola, erythema, urticaria, and purpura. Here only a few instances need be mentioned. Four cases of purpura hæmorrhagica have been described. The most remarkable point about them was their appearance after only small doses; for instance, after 2 or 3 grains every six hours. According to another medical report, a lady of forty got œdema of the face and limbs, with violent erythematous eruptions, followed by peeling, after taking quinine. A repetition of the medicine caused the same symptoms.

The *kidneys and bladder* do not remain insensible to the alkaloid. Given in large doses it may cause albuminuria and catarrh of the bladder. The latter has appeared with violent fever after 60 grains in one day. Cases have been communicated where a few grains of quinine caused bloody urine, jaundice, and fever, apparently quite independently of the malaria for which it was ordered. This is less singular than the skin-eruptions, as the greater part of the quinine which leaves the body passes through the kidneys. The points of particular interest to us regarding this secretion may be noticed here. G. Kerner recovered 80, 90, and 96 per cent. of the ingested quinine from the urine. The excretion of the hydrochlorate of quinine began as early as fifteen minutes after its ingestion, was most active in the twelfth hour (30 per cent.), and lasted till the forty-eighth hour, when 1 per cent. still appeared. The sulphate of quinine was first traceable in the urine after forty-five minutes, and showed itself—1 per cent. only—till the sixtieth hour. The greater portion of both quinine salts passes out in the amorphous modification; a smaller part becomes oxidised.

Abortion and *premature birth* are often attributed to quinine. It seems to the writer, after carefully reading the literature of the subject, that these results are mostly due to the illnesses for which the quinine has been given. As it is a distinct protoplasmic poison, one must admit the possibility that when given in daily long-continued small doses in pregnancy it acts with specific energy on the tender protoplasm of the fœtus, whose gradual decay would lead to evacuation of the uterus. At all events, chronic quinism, even of a mild character, is to be avoided under such circumstances, and regarded with suspicion.

Several cases of so-called contrary quinine-effect, that is a real *febrile attack*, without apparent inflammatien of any organ, have been published from time to time. How they originate is altogether unknown. Even relatively small doses may cause them.

Increase of the *general reflex excitability* has also been described as an unusual effect of small doses of quinine. Epileptic patients are said to react to quinine by increase of their fits in number and severity. This would correspond more with the facts derived from experiments on animals, than the assertion that quinine diminishes greatly the reflex function of the spinal cerd. Such a diminution takes place only when one gives large doses, dangerous to life. Then the reflex function of the spinal cord ceases at the same time as all other functions.

It seems to be an accepted fact that quinine is less injurious to children than to adults.

Quinine has often been employed externally on account of its powerful antiseptic action, without showing injurious effects, when applied in the form of preparations with neutral or weakly alkaline reaction. Repeated frictions of ointment of quinine into the healthy skin cause abrasion and soreness.

Treatment.—The treatment of quinine-poisoning will vary with the various possibilities which have just been described. Should a large dose of quinine be still in the stomach, sickness must be induced by mechanical irritation of the pharynx, or the stomach should be cleared by the pump. Nothing is more unwise than to try to empty the stomach by chemical emetics, such as tartar emetic or ipecacuanha. Firstly, much time is wasted by their application; and secondly—what is still more serious—if they really do act at last, they depress the nervous system and the heart, and diminish the power of resistance to the poison. If any emetic seems to be indicated, only a cautious hypodermic injection of hydrechlorate of apomorphine can be permitted. Tannic acid or carbonate of sodium should be introduced into the stomach before or during evacuation, as quinine salts are precipitated by these bodies in a much less soluble form.

In cases of *acute* quinine-poisoning recourse must be had to artificial respiration, with rhythmical pressure on the heart about thirty times a minute, as it produces strong mechanical irritation of this organ. Further, hot baths (38° C. or 108° F.), with cold affusions over the neck, should be tried. The room and bed in which the patient is lying must be kept as warm as possible. Strong hot coffee or tea is to be administered.

What is to be dene in cases where the quinine has already passed into the blood

has been already indicated. Stimulation of the kidneys is also required, to promote excretion of the alkaloid. Abundance of water containing free carbonic acid, like Seltzer or Apollinaris, mixed with small quantities of wine or other good alcoholic beverage, will answer this indication best.

As the head in such cases is of sufficiently low temperature, in consequence of the general depression of the body-heat, cold compresses to the head are not advisable. This part of the body must be kept rather low, in order to allow the weak action of the heart to fill the brain with renewed blood as easily as possible.

The other symptoms caused by quinine will call for the treatment appropriate to each. Most of them disappear of themselves as soon as the drug is no longer given.

CARL BINZ.

QUINSY (*cynanche*, sore-throat).—A popular synonym for acute inflammation of the tonsils. *See* TONSILS, Diseases of.

QUINTAN (*quintus*, the fifth).—A form of ague, in which the paroxysm returns after an intermission of ninety-six hours. *See* INTERMITTENT FEVER.

QUOTIDIAN (*quotidie*, daily).—A form of ague, in which the paroxysm occurs at the same hour every day. *See* INTERMITTENT FEVER.

R

RABBI, in the Austrian Tyrol.—Chalybeate waters. *See* MINERAL WATERS.

RABIES (*rabies*, rage or madness).—SYNON.: Fr. *la Rage*; Ger. *Hundswuth.*

DEFINITION.—A non-febrile disease, due to a specific poison; and most frequently met with in the canine, feline, vulpine, lupine, and other species of carnivora; but communicable by inoculation to all warm-blooded animals. It is accompanied by an inclination to attack other animals; and is characterised by nervous disturbances, together with listlessness, uneasiness, wildness, cramps, paralysis, rapid emaciation, altered voice, quick course, and fatal termination.

ÆTIOLOGY.—Various antecedent phenomena are supposed to be either the actual or predisposing causes of rabies; but we may say that neither climate, season, food, water, sex, genital excitement, pain, anger, age, nor breed, as far as we are able to judge, has the slightest effect in producing the disease.

Many persons still adhere to the belief that rabies arises spontaneously in the canine, and probably also in the feline, lupine, and vulpine species of carnivora; although most, if not all, of the old school, admit such cases to be extremely rare (Boerhaave, Hamilton, Gilman, Coleman, Renault, Haubner, Williams, Hill, &c.). Others (Maynell, Blaine, Youatt, Virchow, Gerlach, Röll, Böllinger, the writer, and most modern investigators) believe that it never arises spontaneously, but that it is always the result of the introduction of the specific animal poison into the system, either by a bite from a rabid animal, or by the absorption of the virus through the medium of an abraded surface. To prove beyond doubt, in any given case, that affected animals had never been bitten, nor placed in contact with those already diseased, is extremely difficult.

The contagium is universally believed to be a micro-organism, although it has not yet been isolated. According to Pasteur, it is more virulent in the spinal cord than in any other part of the body. We have reason to believe that it is present in the secretions and excretions (Röll, Hering), in the blood, and consequently in all organs and parts of the still warm body (Haubner, Eckel, Lafosse, Röll, Fleming, and others); although others (Breschet, Majendie, Dupuytren), from some cause or other, failed to transmit the disease by inoculation with the blood of rabid animals. Whether the poison is present in the saliva, blood, and other parts during the incubative stage is unknown; but the spinal cord has been found to be inert before the infected animal shows symptoms of the malady, and therefore we may presume that other parts are not poisonous (Dowdeswell). There is no evidence to show that the dried virus is virulent; and the contagium is found to be destroyed by ordinary influences, such as heat, calcium chloride, caustic alkalis, and concentrated acids. It is a disputed point whether the meat and milk of rabid animals are fit for animal food; but few doubt the innocuousness of butter and cheese made from such milk. M. Galtier has found that the saliva of a rabid dog which has succumbed to the disease, or has been killed, does not lose its virulent properties through mere cooling of the body. It is important, therefore, in examining the cavities

of the throat and mouth after death, to guard against inoculation. The same observer has also found that the saliva of a rabid dog, obtained from the living animal and kept in water, continues virulent for five, fourteen, or even twenty-four hours in the case of the rabbit. Water from which a mad dog may have drunk must, therefore, be considered dangerous for at least twenty-four hours. Although previous observations and experiments seem to prove that the virus loses its potency as soon as the body is cold, or *rigor mortis* has set in, and it has therefore been assumed, *à fortiori*, that the flesh of rabid animals might be eaten cooked (Dr. Lecamus) or uncooked (Decroix, Bourrel, &c.) with impunity, even if the mucous surfaces were injured, these statements must now be received with great reserve.

Animals that are inoculated with fresh (warm) saliva, blood, &c., do not in all cases contract the disease. Renault inoculated ninety-nine animals (horses, dogs, and sheep), and only sixty-seven became affected. Röll says that successful inoculations vary from 24 to 70 per cent., whilst from the bites of rabid dogs the proportion varies between 20 and 70 per cent., showing that the disease is comparatively less likely to follow from the natural (bite) than from the artificial (injection, &c.) introduction of the virus. This is probably due to the bleeding produced by the bite washing the poison out again, or to the clothes, hair, &c., of the bitten subject wiping the teeth before they pierce the skin. The researches of M. Galtier seem to show that the diluted poison of hydrophobia, injected into the blood of animals, acts as a preventive of the development of the disease. M. Pasteur has so far completed his experiments as to establish with accuracy the virulence of the poison in the spinal cord of rabbits by subjecting them to various degrees of dryness, its potency being in the inverse ratio of its dryness. It must also be remembered that the percentage—however the poison is introduced—is larger in carnivorous than in herbivorous animals or man. Fleming tabulates them thus: 'Dogs and cats hold the first place in the scale of susceptibility; then man and the pig; next ruminants, the sheep and goat being more susceptible than the ox; and lastly the horse.'

It has been denied by some authorities (Betti, Girard, Vakl, Huzard, Dupuy, Lafosse, &c.) that the virus of other than canine and feline animals, or those which use their teeth as natural weapons of defence, is capable of transmitting the disease to others. But of late years, this has been proved by many (Bourrell, Eckel, Berndt, Youatt, Breschet, Majendie, Earle, and others) to be incorrect.

Incubation.—The period of incubation in rabies ranges between extremely wide limits; but the average period in any animal may be said to be from three to six weeks. It is comparatively shorter in young than in old animals. Spinola said that gestation prolongs it, and according to Fleming it appears sometimes to be hastened by excitement, anger, sexual irritability, terror, injury to the cicatrix, sudden changes of temperature, and other causes. By inoculation the disease develops in from five to fourteen days.

Anatomical Characters.—The anatomical changes in rabies are by no means constant, nor do they at all amount to what one would expect to find, judging from the symptoms presented during life. The following are the principal lesions found:—

The skin may be covered with mud, and wounded, especially about the lips. The visible mucous membranes may be injected; the teeth fractured; the tongue swollen, dark red, and wounded. The mucous membrane of the fauces, larynx, trachea, pharynx, œsophagus, stomach, and intestines may be swollen, congested, or hyperæmic, or may present hæmorrhagic erosions, and signs of catarrh. The tonsils and salivary glands may be enlarged and vascular. The stomach usually contains some indigestible and foreign substances, such as pieces of wood, leather, straw, hay, or iron. These, however, are rarely found in herbivorous animals. The small intestines are usually empty, or they only contain a mixture of bile and mucus. The solitary, agminate, and mesenteric glands may be found enlarged. The spleen is frequently enlarged and congested, hence the disease has often been mistaken for anthrax. The blood is dark-coloured, and coagulates with a soft loose clot. The kidneys and bladder may be hyperæmic, and the latter is usually empty and contracted. The lungs are generally gorged with blood. The vessels of the cerebro-spinal coverings may be congested, and serous effusions in the cavities will sometimes be observed. Williams says: 'On the lower surface of the medulla oblongata, at the origin of the seventh, eighth, and ninth pairs of nerves, the membranes are generally highly congested, thickened, softened, and matted together.' The brain-substance may be soft and friable; there is rarely congestion; and, as a rule, the brain is pale and bloodless (Fleming).

For the microscopical changes, *see* Hydrophobia.

Symptoms.—In the lower animals, the trains of symptoms are so marked that they have given rise to the distinction of two different forms of the disease: one in which the nervous system is excited, hence the terms *furious*, *wild*, or 'excited' rabies; the other, where it seems to be depressed, and to which the names of '*dumb* tranquil,' 'torpid,' or 'paralytic' rabies have been given. Although this distinction is convenient for description, it must not be for-

gotten that paralysis, in some form or other, usually sets in, sooner or later, in the excited form; whereas in the latter it is rarely, and then only for a short time, preceded by any signs of excitement or inclination for mischief. In other words, the symptoms of rabies may be divided into three stages, namely, the *premonitory*, *irritative*, and *paralytic*. In the 'furious' form, all three stages are well-marked; but in the 'dumb' form, only the first and last. The transition from one stage to the other is gradual and imperceptible.

The *premonitory stage* is characterised by an alteration in the manner and habits of the animal. Dogs, for instance, that are naturally friendly and docile, suddenly turn surly and bad-tempered, and as quickly return again to their former docile manner, showing more affection than usual. Nearly all animals are restless, and frequently change their posture and position. Most are dull, lazy, languid, and seek seclusion from society by hiding themselves in dark and quiet places. Irritation at the seat of inoculation, demonstrated by rubbing, nibbling, or scratching the cicatrix, is frequently an early symptom. The appetite is lost, and in ruminants rumination is suspended. Sometimes a depraved appetite is present, evidenced in dogs and pigs by their eating all sorts of strange things, such as wood, iron, &c.; and these, as well as sheep, often swallow their own fæces and urine; whilst the latter have been seen to lick blood and even eat their wool. Carnivorous animals and pigs frequently 'gulp,' as if trying to swallow something, or retch, as though to free their throat from some foreign body; and vomiting sometimes occurs. The visible mucous membranes are red, and saliva almost always (except in horses) drivels from the mouth, due in all probability to dysphagia. The sexual organs of all species, except the pig (Haubner), are frequently excited in the early stage of this disease, and ungovernable salacity is present. The bowels are constipated; the urine is suppressed.

These symptoms may last from twelve to forty-eight hours, and then gradually pass either into the irritative, marking the 'maniacal' form, or into the paralytic stage, characteristic of the 'melancholic' form.

The *irritative stage* is distinguished by a propensity to injure other animals; by great uneasiness; and by paroxysms of fury and excitement, with intervals of quietude and exhaustion.

The increased restlessness, which marks the commencement of this stage, is manifested differently by different animals. They are constantly changing their position and posture. Dogs lie down in one place and quickly shift to another; horses move their ears backwards and forwards, as though they were listening to some distant sound.

During the paroxysms dogs become excited; disturb their beds; tear carpets, mats, or whatever comes in their way; and bite their kennels, chains, other animals, and even their own bodies. They may lie quietly for a time, and then suddenly jump up with a peculiar howl; remain in the same posture for a time; look vacantly around them; then suddenly walk forward as though following something; and all at once snap at some imaginary object. The dog may obey its master's call, although reluctantly, and look up pitifully, as though it did not wish to be disturbed. The tongue is swollen, and frequently dipped into water to cool it, although the poor creature cannot swallow any, and saliva hangs in strings from the angles of its mouth. The countenance is anxious and haggard. If the animal should succeed in escaping from its kennel at the early part of this stage, it wanders forth 'on the march,' apparently not knowing or caring where it goes. If anything comes in its way the dog immediately attacks it, and then resumes its journey. The gait and carriage of the dog are at first natural, but as the nervous energy fails, it becomes unsteady and tottering; the tail drops between its legs; the head is carried near the ground; the abdomen is 'tucked up;' and the poor beast, which a few days previously was plump and fresh-looking, is now comparatively a skeleton. Dogs generally endeavour to retrace their way back to their homes to die. Cats are very savage, arch their backs, lash their tails, and freely use their teeth and claws. Horses become very violent, frequently neigh, bite the bars and mangers, kick, paw, and endeavour to get loose. Cattle rarely, if ever, use their teeth, but bellow, paw the ground, butt and toss, frequently breaking their horns. Sheep seldom, but goats often, use their teeth. Their natural timidity is replaced by a pugnacious disposition, and they will even attack dogs. Pigs slaver at the mouth, bite their fellows and other animals, and become very wild. Poultry make stupid high jumps and other frenzied movements, peck one another, and chuckle frequently. Deer point their noses towards the sky; sniff and throw their heads back, run at other deer, and butt at and fight the trees and other objects, until they even rub the skin off their foreheads; suddenly start galloping, and as suddenly stop, seize sticks and other objects with their teeth, attack persons, eventually become paralysed, and die in from two to eight days. The voice of all animals affected with rabies is altered in character, and is continually being exercised. In dogs, the character of the voice is one of the best diagnostic signs of the disease. It has a peculiar high-toned, croupy, ringing sound, as if the bark and howl were blended together. In the early part of this stage of the malady, the eyes are bright and glaring—especially in cats; but

as the disease advances, the bulbus oculi retracts in its orbit, and the membrana nictitans is forced half over the cornea, giving the animal a horrible and forlorn appearance.

At first the paroxysms are strong and prolonged, but as the disease progresses they become weak and short, and the periods of depression which intervene between the paroxysms are lengthened, until finally the animal has not power or strength to move his limbs, when the *paralytic* stage may be said to have commenced. We now notice continual twitching and convulsions of the muscles—even tetanus; and death soon takes place.

The *paralytic stage* of the 'dumb' or 'torpid' form of the disease is marked by 'dropping' or paralysis of the inferior maxilla, rendering the animal unable to bite or bark. Although at the commencement of this stage there may be an inclination in the dog to leave its abode and 'march;' still it is less so than in furious rabies, and if he do go, the creature either quickly returns again, or seeks some secluded spot in which to die. The animal endeavours to remain quietly in a dark place, and takes little notice of what is going on around him. The tongue is swollen, livid, and hangs out of the mouth; the saliva is tenacious and abundant. Paralysis of the posterior extremities soon sets in, and death quickly follows. When the tranquil form of rabies attacks other animals than dogs, it usually paralyses the posterior extremities.

Duration and Termination. — Rabies generally takes a rapid course, sometimes killing within forty-eight hours, and rarely lasting more than ten days, although cases of canine madness have been reported as having lasted from fifteen to twenty days. The duration depends to a certain extent upon the constitutional vigour of the animal. The termination is fatal in all animals.

Diagnosis.—Marochetti and others have asserted that rabies can be diagnosed a few days after inoculation, by the presence of a sublingual vesicular eruption, but there is no evidence to warrant us in believing this statement; and Mr. Fleming remarks 'that it is much to be regretted that those who have seen these *lyssi* did not resort to inoculation with the contents of the vesicles to prove whether they really contained the morbific elements or not.'

The most characteristic symptom of the 'furious' form is undoubtedly the peculiar 'falsetto termination of the bark' (Horsley); and of the 'dumb' form the dropping of the inferior maxilla. But since these symptoms only appear when the disease is comparatively advanced, we must take other symptoms into consideration, such as the behaviour of the animal, its physiognomy, inclination to bite, and to eat strange and indigestible substances. An acquaintance with the history of the case is necessary if we would avoid confounding it with other diseases.

Epilepsy is distinguished from rabies by the sudden and complete loss of sense, champing of the jaws, foaming at the mouth, convulsions, cries, and rapid recovery.

Distemper has sometimes been mistaken for rabies, from the fact that catarrh of the eyes and nose, giddiness, weakness, and emaciation are sometimes present in both diseases; and it is this circumstance, with the fact that epilepsy is sometimes a sequela to distemper, that undoubtedly led the late Mr. Grantley Berkeley, a professed authority on rabies, to state 'that dogs become utterly insane from distemper, and that if this disease be prevented by vaccination, hydrophobia (rabies) will be decreased.' It is scarcely necessary to say that such assertions are liable to cause serious mistakes.

Foreign substances in the fauces or pharynx, especially in the dog, may be distinguished from rabies by the history of the case, and by careful examination.

Inflammation of the throat only presents one symptom of rabies, namely, inability to swallow.

Gastritis and *enteritis* may be distinguished by the absence of the nervous symptoms, and by the pain produced on pressing the abdomen.

Phrenitis, especially in horses, may be confounded with rabies; but although the animals may be delirious, there is no inclination to do mischief, nor are they irritated by the presence of a dog or a person, and the course of the disease will soon decide the question.

Tetanus in the dog has been confounded with rabies, but this is such a rare disease in dogs, cats, cattle, sheep, goats, and pigs, as to call for no special mention. In horses such a mistake could scarcely happen.

Anthrax.—The pathological changes of rabies and anthrax, says Mr. Fleming, have at times lent some support to the idea that they were identical, or at least resembled each other. Although vertigo, and a disposition to fury, do in some cases accompany anthrax in the lower animals (especially in the horse), the other symptoms of anthrax, the rapidity with which it runs its course, and the pathological anatomy of the several diseases, will serve to distinguish one from the other. The presence of the bacillus anthracis in the blood is absolutely characteristic. *See* Micro-organisms.

Cattle-plague.—The fits of delirium that now and again appear in this disease, as well as the great depression, apathy, and the unsteady gait, have a resemblance to those present in a certain stage of rabies. But this resemblance is very superficial. The existence of the plague in the district, the appearance of the visible mucous membranes, and the other symptoms during life,

as well as the pathological alterations after death, are sufficient to establish a distinction.

A ferocious dog has frequently been mistaken for a rabid one.

There are no *post-mortem* signs sufficiently trustworthy or characteristic to enable us to form a direct diagnosis of rabies. The history of the case, however, together with the facts that foreign bodies are present in the stomach and the mucous membrane of the fauces, larynx, and stomach congested, will materially assist us in forming a correct opinion.

Treatment.—The *curative* treatment of rabies, so far as our experience at present goes, has yet to be discovered; and since the malady is so dangerous to other animals and man, we think its cure ought not to be undertaken, except by experienced persons and under adequate restrictions.

All affected animals should be killed at once and burned, or buried deep with quicklime.

The *prophylactic* treatment, however, deserves our best consideration. If an animal has been inoculated by a bite from a rabid animal or otherwise, the circulation in the part should be immediately stopped by a compress above it; the wound thoroughly washed, sucked, or cupped; and all parts that are supposed to have been in contact with the virus excised, and either the actual or potential cautery freely applied. In the lower animals some of the wounds may escape our notice on account of the hair, and therefore, even after the above precautions are taken, the subject must be treated as suspicious.

The researches of MM. Pasteur and Galtier demonstrate the advantage that may result from inoculation with the attenuated poison, for the purpose of preventing the development of the disease. For a detailed account of these experiments, *see* Hydrophobia.

Cows, sheep, and pigs, if the wounds have been promptly cauterised, may be used for food, provided they are killed within twenty-four hours of the inoculation, and, if Dr. Dowdeswell's experiments are correct, even before any signs of the malady are manifested.

If an animal is suspected of being inoculated from, or has been in company with, one affected with rabies, it should be kept in a secure place, and watched for at least four months, and then only allowed to go out muzzled; but it is preferable to destroy it. If such an animal has bitten any person, it should not be destroyed until it has been positively ascertained whether it is rabid or not.

When a case of rabies has occurred, notice ought to be given at once to the local authorities, to prepare them for making and enforcing stringent measures to prevent its spread. No dogs ought to be allowed to enter public buildings or conveyances, or to frequent the public streets or highways, without a muzzle, under the penalty of being seized by the police. If a rabid animal is at large, notice should be given of the fact to the neighbourhood as soon as possible. All kennels, chains, collars, and places with which a rabid animal has been in contact should be scalded and disinfected.

Dogs should always be under strict police surveillance, by owners not only being compelled to pay taxes, but also by placing evidence of this fact on the dogs' collars in the form of a small metal disc. In addition, every owner should have his name and address on the collar. Should any dog be at large without a collar and the metal disc, it should be at once seized by the police, and if not claimed within a prescribed period it should be destroyed.

George A. Banham.

RACE, Ætiological Relations of.—*See* Disease, Causes of.

RACHITIS (ῥάχις, the spine).—A synonym for rickets. *See* Rickets.

RAGATZ, in Switzerland.—Simple thermal waters. *See* Mineral Waters.

RAILWAY INJURIES.—Description.—The points of difference between railway injuries and those sustained in other ways, such, for instance, as by a fall from a horse or a carriage, are virtually those of degree. The more serious results are referable, firstly, to the great weight and impulse of the railway train, crushing, perhaps completely, some portion of the body; secondly, in the case of collision, to the sudden arrest of momentum of such ponderous bodies in more or less rapid motion, causing thereby violent vibratory shocks to the travellers; and, thirdly, the occurrence being sudden and unexpected, the muscles are, as it were, taken by surprise, and before contraction can take place the ligaments of the spine are frequently strained or even torn. There is no time for preparation; the whole is the work of an instant. In cases of injury to those who jump or fall from a train in motion, the gravity of the resulting injury depends on the rate of speed of the train at the moment; on the part of the body which first strikes the ground, and the angle at which it is struck; on the weight of the individual; and also on the nature of the ground.

Accidents which happen to persons either getting into or out of trains not in motion, possess no special characters. Serious spinal injuries have occurred to those sitting in a train not in motion, when, by a sudden unexpected jerk, as from a train running into it from behind, a violent shock is sustained.

It is, then, the sudden and violent character of the occurrence, the alarm and fright necessarily associated therewith, the general jar or commotion of the system, and the possible localised physical damage, which constitute the main features of this class of injuries, conditions which do not obtain in cases of less sudden violence.

Results. — 1. The *direct* or *immediate* results of railway accidents are of various kinds. Locally, they consist of simple or compound fractures, contusions, and lacerations, caused either by the force of the collision, by the legs being caught between the seats of the carriage, or by the wheels of the carriages where the individual has been run over, or by fragments of splintered wood, iron, or glass. Burns and scalds may add to the sufferings of the injured. These injuries, if not resulting immediately in death, may ultimately prove fatal in various ways, or permanent injury to a greater or less extent may ensue. Such conditions, however, are not peculiar to railway injuries, and need no special description here.

The immediate effects on the cerebrospinal system are, on the other hand, of special interest and importance. Local injuries to the spinal column and cord, or to the head, are frequently met with, such as fractures of the skull or of the spine, implicating the brain or spinal cord or their membranes, stretching or rupture of spinal ligaments, &c., and these *ligamentous* lesions are, perhaps, the most characteristic features of railway injuries. Death has resulted from sheer fright; the influence of intense fear on the minds especially of persons suffering from heart-disease, aneurysm, and the like, being sufficient to cause death. The primary depression produced on the nervous and circulatory systems continues and deepens, there is no power to rally, and a fatal result from syncope ensues. A general condition of shock or concussion is also commonly met with, where the symptoms presented are mainly subjective; and in emotional individuals an attack of acute hysteria may be induced, laying the foundation of a chronic condition.

For a description of concussion of the cord, and of the localisation of lesions of the cord, *see* Spinal Cord, Diseases of.

2. The *indirect* or *remote* results of railway injuries are numerous and varied in character. *Locally*, it must not be forgotten that an accident may readily light up chronic inflammatory mischief in individuals who are predisposed by some inherited or acquired weakness, or by some particular diathesis. Thus syphilitic, tubercular, gouty, and even cancerous disease may follow and complicate the symptoms arising from the injury. Again, chronic inflammatory conditions of the spinal cord and its membranes may be induced thereby, and the usual train of symptoms accompanying such lesions will be manifested. But, apart from the existence of such organic mischief, certain indefinite phenomena, subjective and functional in character, are constantly met with, which render the diagnosis and prognosis of railway injuries difficult, and considerably increase the responsibilities of the medical attendants. It is especially, however, when there is no local lesion of importance, such as a fractured limb, that these general 'neurasthenic' conditions are likely to occur; for it can be readily understood that if the force of the accident expend itself upon some injury, say, to one of the extremities, there is less likelihood of a general concussion of the nervous system. The familiar and often-quoted illustration is that of a watch, in which the works are less likely to be damaged by a fall if part of the violence be expended in breaking the glass. This neurasthenic condition is evidently the expression of an exhausted nervous system, and may come on in various ways and at various times after the accident. The mental shock is to be held responsible for its occurrence nearly as much as is the physical. It may arise out of the general collapse or shock into which the patient has been suddenly thrown by the accident, but perhaps more commonly the extent of the mischief is not evident at the time. As a typical illustration of such a case, the following may be taken: A person in a collision receives a sudden, unexpected, and violent shock, the result of being thrown or jolted backwards and forwards. He feels faint and collapsed for a few moments, but recovers sufficiently to be able to assist his fellow sufferers; returns home, and resumes his usual avocations. After an interval of a day or two he begins to complain of pain and stiffness in the back and neck, but particularly in the lumbodorsal region. He goes to his business, but cannot attend to it, being unable to concentrate his attention or make calculations, any special effort resulting in marked occipital headache. He is unable to read comfortably, as the letters run into one another and become blurred. He goes home and consults his medical man, who probably advises rest in bed, and prescribes bromide of potassium, &c. The temperature in these cases is often subnormal, and the pulse slow, except when agitated as by a medical examination. These symptoms in the majority of cases pass away after a short rest, and terminate in complete recovery. In other cases, fortunately the exceptions, further symptoms develop, such as irritability of the bladder, inability to empty the viscus, occasional dribbling of urine, lightning pains in the spine, spasm of the legs, and others too numerous to mention here. These may depend either upon the condition of neurasthenia, just alluded to; or more rarely upon definite congestive or other pathological changes occurring in the

spinal cord. The prognosis of the latter is grave in the extreme.

In the condition of neurasthenia, asthenopia, with difficulty in or real loss of the power of accommodation, may be one of the causes of the impaired vision just mentioned. Physical changes in the retina and optic disc, such as those detailed by Dr. Clifford Allbutt, are extremely uncommon, and the latest writers on this subject, namely, Mr. Page and Mr. Thorburn, seem to doubt their occurrence. In all probability, they only exist as sequelæ of organic lesions of the spinal cord and membranes.

Added to this neurasthenic condition, there is often seen a certain amount of functional disturbance, probably of cerebral (cortical) origin, which may be described as chronic hysteria, under which one includes changes of various kinds in the cutaneous sensibility, spasmodic contractions of limbs, and paralyses; and it is often a most difficult question to decide whether these phenomena are functional or real. Cases such as these are frequently the subject of litigation as regards claims for damages against railway companies.

Medico-legal Questions in Connexion with Railway Accidents.—In cases of claim for compensation for these injuries, it is of the highest importance that the medical men engaged should make themselves thoroughly acquainted with all the circumstances connected with the accident and its results. This applies to the *medical attendant* of the injured person, as well as to the *medical officer* examining on behalf of the company.

Duties of the Medical Attendant.—1. It is desirable to obtain in writing the *patient's statement* as regards: (*a*) the accident; ascertaining, if possible, the approximate speed of the train when the accident occurred, the position of the injured person in the carriage, and of the carriage in the train; also whether other persons were present or not; (*b*) his condition from the time of the accident to the time of his examination; and (*c*) the symptoms complained of at the time of his examination.

2. Investigate the general condition of the patient, especially as to his appetite, and his capacity for sleep or work; ascertain also his previous habits. The possible existence of organic disease, previous to the accident, should not be overlooked, as it has happened that symptoms referable to disease—tabes dorsalis, for example—have been erroneously ascribed to injury. The urine should be carefully examined in every case.

3. Note bruises or any sign of local injury on any part of the body.

4. Where injury to the spine is alleged, the investigation should be conducted as far as possible according to the following systematic plan:—

(i.) Notice the amount of mobility or rigidity of the spine whilst the patient is undressing.

(ii.) Examine the spine by digital pressure or percussion, and by the application of hot or cold sponges.

(iii.) Investigate any alleged paralytic symptoms by (*a*) measuring the circumference of the limbs, where needful; the right side, it should be remembered, is usually somewhat fuller than the left, and the existence of any other pre-existing inequality of the limbs should not be lost sight of; (*b*) testing the electrical excitability of the muscles; (*c*) noting the existence of spasm or tremor of the muscles of the spine and limbs; and (*d*) examining the condition of the reflexes, superficial and deep.

5. Investigate the presence of any abnormal cutaneous sensibility. This is entirely a subjective phenomenon, on which reliance cannot always be placed.

6. Ophthalmoscopic examination must be made, in order to determine the existence or not of local lesion in the fundus oculi, confirmatory or otherwise of cerebral or spinal symptoms; but, as already stated, such pathological changes are exceedingly rare.

During this examination, it should be borne in mind that the simulation of symptoms, such as spinal tenderness or muscular tremor, can frequently be detected by distracting the attention, when pressure on the part previously complained of may be made with impunity, or the muscular tremors will cease. This, however, is not conclusive of imposture, for in hysteria, when the attention is diverted, the same occurs.

As an instance where the truth of a patient's statements may be tested by the astuteness of the medical man, a case may be mentioned in which the plaintiff, who had travelled up some fifty miles to London to be examined, stated, among other symptoms, that his urine continually dribbled from him. The surgeon immediately asked to see his shirt, which had been worn at least six hours, when it was found perfectly dry and devoid of any stain of urine! In another case a man presented extreme spinal tenderness, even to the extent of complaining of pain when the part was blown upon with the breath. A sheet of paper being interposed, without the patient's knowledge, the effect was the same.

It now becomes the duty of the medical attendant to form an opinion on the following points:—

(*α*) Has the patient been really injured?

(*β*) What is the nature of the injury?

(*γ*) Is the injury a possible or probable result of the accident as described?

(*δ*) Are the symptoms consistent with the history and the objective signs?

Duties of the Medical Officer examining on behalf of the Railway Company.—The medical officer of the

company should on no account constitute himself the agent of the company for settling the terms of compensation. The examination should be made, if possible, in the presence of the medical attendant of the patient, and not in the presence of the legal advisers of either side; it should be conducted with thoroughness and tact, and without inflicting any unnecessary mental or bodily pain.

A report of the case should be drawn up at the time, giving :—

(1) The patient's account of the accident, and of his subsequent and present symptoms.

(2) The present condition of the patient, noting particularly any objective signs of injury.

(3) An opinion as to whether the symptoms complained of are likely to be the result of the accident; and as to the probability of recovery, and at what period.

As the plaintiff's solicitors in an action can apply for a copy of this report, it should, of course, be worded with extreme care.

The actual question of pecuniary compensation does not concern either the medical attendant of the patient, or the medical adviser of the company. They merely have respectively to bring forward facts in support of their opinions as to the value of symptoms, and how far they are dependent upon the injury.

Such investigation should take place as soon after the accident as possible, by which means the chances of imposture would be lessened; whilst by a careful and impartial estimate of the facts of the case as obtained by such a thorough examination as that sketched above, much conflict of medical opinion would be avoided, the medical men being witnesses, not advocates.

Fraudulent Claims.—It will be well to allude to some of the ways in which fraudulent claims are brought against railway companies. These may be conveniently divided into :—

(1) Claims made by persons who, as may be subsequently proved, were not even present at the time of the accident;

(2) Claims by those who, though present and unhurt, yet simulate the symptoms of injury; and

(3) Claims by those who, having sustained some trifling injury, wilfully and intentionally exaggerate their symptoms in order to obtain a larger amount in compensation.

The medical man should, therefore, be alive to the possibility of wilful deception being practised on him, lest he should be led away by a well-planned history, and thus unwittingly be made a party to such fraudulent transactions.

Unintentional Exaggeration.— The difficulty of assessing the value of subjective symptoms in general is much increased by the fact that there are certain persons who, undoubtedly injured, may, without any fraudulent design, unintentionally exaggerate their symptoms. This is to some extent explained by their thoughts being constantly directed to their sufferings, and the worry necessarily attending a protracted lawsuit, or whilst an action for damages is pending. The suspense and anxiety, the examinations by the medical men, and the repeated interviews with their solicitors, keep them in a constant state of nervous tension. When, therefore, their claims are settled, it is natural that the relief they experience should frequently be attended by beneficial results, or even complete recovery. *See* FEIGNED DISEASES.

TREATMENT.—The chief injuries received at the time of a railway accident being surgical, the treatment adapted for each particular case will be found in surgical works. Nevertheless there are some general points in the immediate treatment to which any medical man present on such occasions would do well to attend.

1. *Hæmorrhage.*—Death from hæmorrhage should be prevented, where possible, by promptly adopting pressure of some kind. If no tourniquet or indiarubber band be available, a handkerchief tied round the limb and twisted tight with a piece of stick, or direct pressure by the finger, will suffice for the time.

2. *Fractures.*—Temporary splints may be improvised out of umbrellas, walking-sticks, cushions, newspapers, and broken pieces of wood, &c., fixed by straps or handkerchiefs, so that the injured may be removed with as little pain as possible, and simple fractures may be prevented from becoming compound. Simple dislocations should be reduced at once, if possible.

3. *Shock, collapse, and fright.*—In the treatment of these conditions great caution is required to maintain the vital powers until reaction sets in. The temperature of the body, the strength and rate of the heart's action, together with the respiration, should be kept up by stimulants and warmth. Sir William Savory, in his article on 'Shock' in Holmes's *System of Surgery*, is careful to point out the dangers of *over*-stimulation, whereby the flickering powers of nature may be extinguished altogether.

4. *Exposure to wet and cold.*—Every endeavour should of course be made to prevent prolonged exposure, by sheltering the injured as much as possible, and securing their early removal to any neighbouring houses.

The subsequent treatment of railway injuries is one which requires the exercise of considerable skill and judgment on the part of the medical attendant. Absolute rest is of course a *sine quâ non* where any spinal concussion or local lesion is suspected; but

where the symptoms are due to neurasthenia, long confinement in the horizontal position is often productive of harm, whereas change of scene and moderate exercise might prove beneficial.

William Rose.

RÂLES (Fr., Rattles).—Certain adventitious sounds heard on auscultation, in connexion with the respiratory organs, during the act of breathing, in various morbid conditions. *See* Physical Examination; and Rhonchus.

RAMOLLISSEMENT (Fr., Softening).—This word is associated with all forms of softening of tissues and organs; but by English pathologists it is generally used in connexion with softening of the central nervous system. *See* Softening.

RANULA (*ranula*, dim. of *rana*, a frog). A cystic growth in the floor of the mouth. *See* Mouth, Diseases of.

RAPE.—Synon.: Fr. *Viol*; Ger. *Nothzucht.*

Definition.—By the English law rape is defined as 'the carnal knowledge of a woman forcibly and against her will.'

General Remarks.—The crime of rape is punishable by penal servitude for life. By the Criminal Law Amendment Act of 1885 the defilement of a girl under thirteen is a felony punishable by penal servitude for life, and the attempt to have carnal knowledge of a girl under thirteen is a misdemeanour punishable by two years' hard labour, or by a whipping if the offender be under sixteen. The carnal knowledge of a girl between thirteen and sixteen, or the carnal knowledge of an idiot or imbecile girl, is a misdemeanour punishable by two years' hard labour.

Of cases of rape recorded by Casper, 73 per cent. were upon the persons of little children under twelve. Of 136 cases put upon record by this author, the ages were as follows:—

From $2\frac{1}{2}$ to 12	years of age,	99 cases
„ 12 „ 14	„ „	20 „
„ 15 „ 18	„ „	8 „
„ 19 „ 25	„ „	7 „
47	„ „	1 „
68	„ „	1 „

For proof of the crime of rape it is not necessary that the force employed should have been of a violent physical kind. A mere *threat* of violence, or even of moral injury, is 'force' in the eyes of the law. The surreptitious administration of chloroform, or a narcotic, for the purpose of having intercourse with a woman against her will, is also force in the eyes of the law. The Criminal Law Amendment Act quoted above has the following clause: 'Whereas doubts have been entertained whether a man who induces a married woman to permit him to have connexion with her by personating her husband is or is not guilty of rape, it is hereby enacted and declared that every such offender shall be deemed to be guilty of rape.'

The moral character of the woman is theoretically, but seldom practically, beside the question; and, provided force be used, and the woman's consent be wanting, sexual intercourse even with a prostitute is legally 'rape.'

The punishment of the crime of rape was provided for in the criminal code of Moses, who ordained that the ravisher of a betrothed damsel should die.

The Roman law punished the crime with death and confiscation of goods, but provided the following saving clause:—

Rapta raptoris, aut mortem, aut indotatas nuptias optet.

Upon this, says Percival, there arose what was thought a doubtful case: '*Una nocte quidam duas rapuit*; *altera mortem optat, altera nuptias.*'

Many accusations of rape are false and trumped up, and are only brought by the woman when she finds that some sexual indiscretion is likely to bring her into trouble, or cannot be concealed by reason of her pregnancy.

This being the case, *stale accusations* should be received with very great caution. The laws of Henry III. provided that the accusation should be made immediately '*dum recens fuerit maleficium.*' By the old Scotch law no delay was allowed in bringing the accusation *ultra unam noctem*, and by the modern Scotch law a delay of three days is alone permitted. By the law of England no limit is placed on the time at which an accusation of rape may be made. An English jury is, however, naturally chary of giving credence to a stale charge of rape. Some few years back a charge of rape was brought against a gentleman of position in one of the home counties by a girl with whom he had had connexion some five months previously. There was no evidence that the girl had offered any resistance, and as the accusation was brought only after pregnancy had become evident, and after ineffectual attempts had been made to extort money from the defendant's relatives, and as the charge was evidently made at the instigation of an uncle who was a superintendent of police, and a cousin who was a lawyer, the case was dismissed. It shows, we think, an imperfection in the English law that it should be possible, under such circumstances, to prefer a charge of so serious a crime.

The law for the substantiation of a charge of rape is satisfied with proof of a minimum amount of 'carnal knowledge.' The mere touching of the vulva by the penis is carnal

knowledge in the eyes of the law. The complete introduction of the penis into the vagina need not be proved, and still more is proof of emission unnecessary.

The Signs of Rape.—From what has gone before, it is evident that there need be no signs whatever. If a girl be overawed by a threat and her vulva be touched by the penis, that is rape; and, if proved, is punishable as such.

On the other hand, the evidence of rape may be very convincing; for example:—

(*a*) The woman may have been heard to cry for help.

(*b*) There may be the signs of a struggle at the spot where the rape was alleged to have occurred.

(*c*) There may be damage to the woman's clothing, and bruises of various parts of her body—signs that she has been subjected to physical force.

(*d*) The genital organs may be found injured; the vulva bruised and perhaps bleeding; the hymen recently ruptured; and, in cases where the disparity in size between the man and woman is very great, rupture of the perinæum and mortal injuries to the vagina.

(*e*) Seminal spots may be found upon the woman's clothing, which is a certain proof of a previous 'intimate relation' with a male. Blood-spots also afford valuable evidence, but necessarily not so conclusive. Care must be taken not to confound menstrual fluid with blood.

The concurrence of all these signs would amount to certain evidence of forcible connexion. It must be borne in mind, however, that violence may be done to the female organs in other ways than by forcible connexion, and the medical examiner should be upon his guard against inferring too much from the evidence afforded. He also should be on the look-out for facts which may rebut assertions made by the woman. Thus, signs of a previous pregnancy or the evidence of previous venereal disease (scars in the groin, sores upon the pudenda, or symptoms of constitutional syphilis) may serve to disprove any assertions which might be made as to the woman's virginity or previous chastity. To *prove* whether or no a woman be '*virgo intacta*' is next to impossible, and we can only state the probabilities for and against. Such a question, however, is quite beside the mark in many cases of rape; but the presence of an unruptured hymen is an unlikely occurrence after forcible connexion. An examination of the person of the supposed ravisher may afford some corroborative evidence. Blood or recent seminal spots upon the linen or clothing, and injury to the person or clothing, all afford their quota of evidence of a sexual act combined with violence.

It is a matter of doubt whether the rape of a woman of fair size and strength be possible by an unaided man. If a woman be in the enjoyment of her faculties she is capable of offering an amount of resistance which would be well-nigh insuperable; and if she have offered a decent resistance, the person of the ravisher should bear evidence of it.

Rape, as we have seen, is most often committed on children of tender years. It is well to be on one's guard against error with regard to the rape of little children. It must have come within the experience of most members of the profession, and especially of those engaged in hospital practice, to have brought to them children suffering from a purulent discharge from the vagina, the mother at the same time alleging that some one must have violated the child. It must be borne in mind that purulent discharges from the vagina are not uncommon in ill-fed, dirty, scrofulous children; and that after some of the infantile acute specifics, sloughing of the pudenda is a rare, though recognised occurrence. The case of Jane Hampson, æt. 4, who died of sloughing of the genitals at Manchester in 1791, should stand as an incentive to caution in these matters. The signs were considered as those of defloration, and the coroner's jury returned a verdict of *murder* against the boy who slept with her; but luckily for the male child there occurred many other cases of sloughing of the pudenda in Manchester before he was brought to trial, and as the doctor who was called to Hampson recognised and acknowledged his error, the boy was discharged. It was at one time a popular belief that connexion with a virgin was a sure cure for venereal disease, and this has led, no doubt, to many cases of rape on young children. The presence of venereal disease in one or both of the parties may be of value as evidence. Its presence in the woman and not in the man affords a strong presumption against rape.

The finding of spermatozoa within the vagina is proof positive of connexion. But here, again, care must be taken not to mistake for spermatozoa the *trichomonas vaginalis*—a microscopic organism, not unlike a tadpole in shape, which has been described by M. Donné, as occasionally found in vaginal mucus. It must be remembered, also, that seminal fluid may contain no spermatozoa. Rape is occasionally effected with so much violence that death results. Ogston records the case of one Margaret Paterson, who was raped between Edinburgh and Dalkeith by two carters, who took her into their cart on the pretence of helping her on her journey. They forcibly held her down and repeatedly violated her person, and afterwards took stones from the road, coals, straw, prickly plants, &c., and forced them into the vagina. They then left her in a ditch, and she died in three days of her injuries. *Post mortem* the vagina and rectum were found lacerated and broken down into one passage,

and the abdominal viscera in a high state of inflammation. The two carters were convicted and executed. This case does not stand alone, for it is an interesting fact that rape has not infrequently been accompanied by acts of violence which are not only brutal and senseless, but which appear to have no relation to sexual acts or feelings.

It has been doubted whether pregnancy can follow rape, but there seems to be no sufficient grounds for this doubt.

Duties of the Medical Examiner.—When called to a case of supposed rape, the medical examiner must remember to take note of every circumstance—the time that has elapsed since the alleged outrage, the mental state of the woman, her size and physical power as compared with that of the man, and evidences of a struggle in the surroundings of the woman, or on her clothing and person. He should keep his mind open to receive any facts which may throw light on the moral character of the woman. He should accurately take note of the exact condition of the genital organs and linen; should take possession of all stained linen for the purpose of chemical and microscopic examination; and should remove a portion of any discharge which may be found in the vagina for the same purpose. In drawing up a report, he should describe, as accurately and drily as possible, all facts which he may notice; and should be carefully upon his guard against drawing any undue conclusions from those facts. G. V. Poore.

RASH.—An outbreak of redness of the skin, or efflorescence; called by the Greeks an *exanthema*, or blossoming out. The word rash, or as it were 'rush,' conveys the idea of suddenness, whilst in reference to development it is generally extensive. The best illustrations of the rashes and of the meaning of the term are erythema, the red rash; roseola, the rose-rash; rubeola, the crimson rash, generally known as measles; scarlatina, the scarlet rash; purpura, the purple rash; and urticaria, the nettle rash.

RATIONAL (*ratio*, reason). In conformity to reason.—A term applied to the mental state; also to treatment when founded on scientific principles, in contradistinction to *empirical* treatment, founded solely on experience. *See* Consciousness, Disorders of; and Disease, Treatment of.

RAYNAUD'S DISEASE.—Synon.: Symmetrical Gangrene; Fr. *Gangrène Symétrique*; Ger. *Symmetrische Gangrän*.

History and Definition.—This disease was originally described by Maurice Raynaud in the year 1862, under the name of Symmetrical Gangrene. The diseased state, in its mildest form, he termed 'local syncope.' To more severe cases he gave the name of 'local asphyxia;' while a still more aggravated form of the malady was designated by him 'local' or 'symmetrical gangrene.' The stage of local syncope is accompanied by coldness and pallor of some portion of the extremities. This is popularly known as the 'dead finger' stage. In the second stage, that of local asphyxia, the same parts become not alone cold, but more or less cyanotic. They assume a bluish-black tint, as though stained with ink. In the third stage, that of local or symmetrical gangrene, actual mortification not infrequently ensues. Raynaud further showed that the various symptoms are to be ascribed to a spasmodic contraction of the arteries and arterioles.

Ætiology.—This disease may occur at almost any period of life. It is especially common amongst young children. In a series of papers published in the *Lancet* in July and August 1889, the writer referred to 93 cases which he had collected and analysed. The youngest subject of the disease was two and a half and the oldest fifty-nine. Of the 93 cases, 54 were females and 39 males. The disorder, therefore, is more prevalent among women than among men. These tables further show that a large proportion of the sufferers were young children, 24 of the 93 being under ten years of age. In early life also the cases often assume a singularly acute and malignant form. Indeed, in some instances, the child has died in from thirty to forty hours, the progress of the disease being continuous from bad to worse; no paroxysmal attacks occurring at any time. According to Raynaud, females between the ages of eighteen and thirty are particularly liable to be affected. This opinion is not supported by the statistics above referred to. From them it appears that the disorder is pretty equally distributed between the different decades of life; though, as already stated, it is especially prevalent among the young. Indeed, in no fewer than 13 cases, the age of the patient ranged from two and a half to five years; in 11, from five to ten; in 15, from ten to twenty; in 16, from twenty to thirty; in 15, from thirty to forty; in 13, from forty to fifty; and in 10, from fifty to sixty. Raynaud considered suppression or irregularity of the menstrual functions a frequent exciting cause of symmetrical gangrene; but this opinion is only partially confirmed by subsequent writers. Cold certainly is a very powerful factor in exciting the attacks; indeed, the great majority of cases are directly referable to the effects of cold, and occur far more frequently in winter than in summer. Still, well-authenticated cases have been recorded where paroxysms of the disease proved especially severe even during the hottest weather. Sudden emotion and mental shock have in some instances excited an attack. It further appears that a considerable number of those who have suffered from Raynaud's

disease may be looked upon as hysterical, emotional, and excitable persons, in whom the neurotic element is highly developed. Indeed, there is every reason to believe that the unstable equilibrium of the nervous system is a potent predisposing factor in the pathogenesis of the disease.

Symptoms.—In a typical case, observed by the writer, the symptoms commenced by a tingling sensation in the fingers and in the ears, which burned and itched as though they had been stung by nettles. The tingling was succeeded by icy coldness in the parts affected. The patient noticed at the same time that tactile sensation in his fingers was altogether lost. If he attempted to pick up any small object he was not conscious of holding it, unless his eyes were actually fixed upon it. This extreme coldness in the fingers lasted for five or six weeks; the parts felt icy to the touch, and looked white and bloodless. They were constantly blanched, and did not resume their natural tint. All the digits of both hands were affected. The thumbs also suffered, the nails being markedly exsanguine. Here was illustrated the stage of local syncope. After remaining white for about six weeks, the fingers assumed a bluish shade; they became cyanotic, and in the course of a few days turned black, as though dipped in ink. The nails also remained bluish-black. With this change in their colour, the parts grew painful. So long as they remained white, they merely felt numb; but in proportion as the dark shade became more pronounced, so was the pain more severe. The cyanotic tinge occupied nearly the whole of the phalanges of the several fingers, the digits of the right hand also being symmetrically affected. Soon after the fingers became blue, the ears also assumed a similar shade. The tip of the nose likewise was of a bluish-black tint, while the alæ nasi on each side looked purple and congested. Here local syncope was succeeded by local asphyxia. In the course of a few days a further change was noticed. The skin, over the black portion of the fingers, more especially over the bulbs, separated from the parts beneath, and was cast off in small sloughs. It was then seen that the derma was extensively destroyed; its surface looked honeycombed, numerous little ulcers eroding the deeper tissues. A few days later a portion of the helix of the right ear sloughed away, the cartilage being at the same time destroyed. Here the well-marked features of symmetrical gangrene were characteristically developed. In still more severe cases the progress of the mortification is far more rapid. The affected parts are frequently covered with beads of sweat; a large slough forms, and a finger, or even whole segments of limbs, may mortify and separate. The lesions of the nervous system are very numerous; indeed, the brain, spinal cord, sympathetic system, and peripheral ganglia, may be severally, or together, involved. Hence it is reasonable to expect that the symptoms should prove proportionately varied and uncertain, and that in one case a terminal phalanx of a single digit may be alone affected, while in another a whole limb may be rapidly destroyed and cast off as a lifeless mass. In many characteristic cases, not alone are the fingers, toes, ears, and nose simultaneously attacked, but also other portions both of the trunk and of the limbs; parts, in fact, in which each side of the body has its corresponding counter-part on the opposite side, are at the same time involved. These patches have been observed over the heels, over the calves, and over the tibiæ. In several cases the nates have been affected; in others the cheeks and the mammæ. Raynaud speaks of the coccyx being occasionally implicated; and in one curious case the tip of the tongue felt numb, and turned a bluish-black colour.

Associated Diseases. — Numerous observers have referred to the fact, now well-established, that in a considerable number of cases intermittent hæmoglobinuria is associated with symmetrical gangrene. Indeed, occasionally a well-marked attack of hæmoglobinuria may occur instead of a paroxysm of local asphyxia, or, as not unusually happens, a patient suffering from symmetrical gangrene may at times pass urine more or less bloodstained and dark. But, closely allied as these two affections admittedly are, important points of distinction may still be noted between them. In the first place, hæmoglobinuria is, in the majority of cases, accompanied by far more grave constitutional symptoms than are usually observed in cases of symmetrical gangrene. In the latter disease, even though the extremities are gangrenous, the sufferers often look remarkably healthy and vigorous. The subjects of hæmoglobinuria, on the other hand, are usually spoken of as sallow and cachectic. Among them disturbances associated with the abdominal organs, such as pain and tenderness at the epigastrium, irritability of the stomach, feelings of nausea or actual vomiting, are often observed. Then, again, not a few of the sufferers from hæmoglobinuria have experienced attacks of malarial fever; in symmetrical gangrene this complication is comparatively rare. And lastly, while Raynaud's disease is seen most frequently among females, hæmoglobinuria prevails to a far greater extent among males.

Various skin-affections not infrequently are associated with attacks of local asphyxia and gangrene. In some cases patches of subcutaneous mottling; in others a peculiar marbling of the surface; in others, again, urticaria; in others an eruption of wheals or chilblains; in others, well-marked scleroderma of various parts of the body, have been

described as occurring with more or less frequency. In several instances (10 out of 93) syphilis, either acquired or congenital, has been noticed. In one case seen by the writer many of the symptoms characteristic of tertiary syphilis were at times replaced by those changes in the extremities which constitute a distinguishing feature of Raynaud's disease; while both the syphilis and symmetrical gangrene eventually disappeared under the use of antisyphilitic remedies. Although peripheral neuritis has, in a considerable number of instances, been noted by competent observers as occurring in these cases, still there are reasons for believing that it cannot be looked upon as an essential factor in the pathogenesis of this disease. In the great majority of instances, the lesions undoubtedly are symmetrical; still, a symmetrical distribution of the patches is by no means universal; indeed, in 8 out of 93 cases no traces of it could be discovered.

Pathology and Morbid Anatomy.—The conclusion at which Raynaud arrived, that the disease is due to a spasmodic contraction of the arteries and capillaries in certain parts of the body, has been fully confirmed by subsequent authorities. We must assume that a sensation, as, for example, of cold, is transmitted by the sensory nerves to an excito-motor centre in the cord, and from that centre a stimulating influence is reflected along the vascular nerves, which causes the vessels to contract. Raynaud proved that there could be no actual obstruction within the arteries, due either to arteritis or to mechanical closure, because injections made in corpses penetrated readily into the parts affected by gangrene. He further showed that the change was not to be ascribed to any congenital or acquired narrowing of the arteries; that it was not dependent on embolism; and was in all respects distinct from the gangrene of diabetes mellitus and ergot of rye; and he strengthened his views regarding the nature of the affection by his observations on the narrowing and constriction of the arteries in the retina, which he observed in a remarkable case of symmetrical gangrene which came under his care in the month of April 1872. But the question naturally arises, What are the portions of the vascular system which are more especially affected in symmetrical gangrene? Some authorities consider that the arterioles are alone involved; others maintain that the capillaries also are spasmodically contracted; while others assert that the process may be solely confined to the veins. A study of the phenomena which accompany the disease seems to show that in local syncope, when the ischæmia is extreme, arteries, capillaries, and venules are alike affected by the spasmodic constriction, and are all contracted. After a time, however, when local syncope is succeeded by local asphyxia, the veins, to which the muscular elements are more sparingly distributed than to the arteries, are the first to dilate, the latter remaining impervious. In a still later stage of the disease we observe changes similar to those with which Cohnheim has made us familiar, when the terminal arteries are closed by an embolus, venous blood unsuited to the nutrition of the parts regurgitating from the veins into the capillaries and arterioles, and setting up in the tissues supplied by them more or less destructive changes. In these cases true mortification may occasionally ensue.

Diagnosis.—Symmetrical gangrene is thus distinguished from senile gangrene. It is usually symmetrical, and occupies two similar extremities, or all four at the same time. The nose and ears also are often similarly affected. Senile gangrene, on the other hand, almost invariably attacks a single limb, generally one of the lower extremities. Further, senile gangrene mostly invades the deeper parts; symmetrical gangrene is more frequently confined to the skin and the contiguous parts. In senile gangrene the arteries are hard and atheromatous; in symmetrical gangrene the pulsation and coats of the vessels are generally normal. Senile gangrene also is, as its name implies, essentially a disease of the old. In Raynaud's disease, the average age of 93 sufferers was about twenty-six. In gangrenous ergotism the constitutional symptoms are, as a rule, far more severe than in symmetrical gangrene. At the same time, the latter disease is more frequently observed among women, while the gangrene of ergot is rare among females; and, further, in this disease the upper extremities are but seldom involved.

Prognosis.—Considering the severity of the symptoms, in many cases of symmetrical gangrene the mortality is considerably less than might have been anticipated; still, it appears from the tables to which reference has been made that in 15 out of 93 cases the patients died while under medical observation. Several of these deaths, however, were attributed to phthisis, or some intercurrent attack of disease. Many of the deaths also occurred amongst young children, in whom the intensity of the symptoms is very marked.

Treatment.—Raynaud entertained a very high opinion of the value of galvanism in these cases. Electricity was, in his practice, usually employed for ten minutes or a quarter of an hour daily, descending currents being always recommended. The positive pole was applied over the spinous process of one of the lower cervical vertebræ, while the negative pole was placed over the lumbar region. In his hands the success of this mode of treatment seems to have proved very remarkable. Other writers recommend that the affected hand or foot be immersed

in a basin of hot water, in which the negative electrode is placed, while the positive is applied over the spine or the upper part of the limbs. At the same time, it is advisable that persons suffering from paroxysmal attacks of any stage of Raynaud's disease should be, as far as possible, protected from cold, by having their extremities swathed in cotton-wool and enveloped in flannel. In very severe cases the patients should even be confined to their beds. Where a syphilitic taint is suspected, recourse must be had to mercury and iodide of potassium; in cases complicated by ague, quinine has in several instances proved useful; in the more chronic forms of the affection, where the joints are implicated, massage may be expected to prove beneficial. In other cases, where pain is the most characteristic symptom, the subcutaneous injection of morphine, especially when combined with atropine, has, in the writer's experience, given more relief than any other remedy. Belladonna, nitrite of amyl, and nitroglycerine, drugs which induce dilatation of arteries, though occasionally prescribed, have, on the whole, proved disappointing in their effects.

John Edward Morgan.

REACTION.—When any substance or influence affects the organism sufficiently to cause appreciable physiological disturbance within it, it is said to have a *physiological action* upon the body; or, more briefly, to *act* or to have an *action* upon it. If the effect of such an influence have been well-marked, the organism does not always return to the original or ordinary condition, or to what is called the 'physiological balance,' with the cessation of the influence; but may pass beyond it into a state characterised by phenomena which are, speaking broadly, the opposite of the former. The condition which is thus the effect or outcome of the *action* is called the *reaction*; and the same name is also given to the *process* by which the primary effect passes into the secondary. The cold bath furnishes a familiar illustration of physiological action and reaction. The contraction of the superficial vessels, the pallor, the sensation of intense cold, and the fall of temperature, which are the immediate effects of the cold bath, are speedily replaced by such exactly opposite phenomena as dilatation of the cutaneous vessels, flushing of the skin, a warm glow, and a rise of temperature; and in the same way the primary nervous stimulation gives way to a feeling of general calmness and comfort. It is usually found that the phenomena of action and reaction are in direct proportion to each other, unless the action be excessive, in which case reaction may not set in. In other instances the irritability or excitability of the organism, whether as a whole or in part, may be either unnaturally increased or unnaturally diminished, and the reaction be either *excessive* or *imperfect* accordingly.

Excessive emotional excitement, whether pleasurable or painful in nature, such as joy or fear, may similarly be followed by corresponding depression, by prostration, or even by death. In the reaction which follows severe injuries, especially when they are met with under circumstances of intense fear—for example, in railway accidents—both the bodily and the mental functions, so called, are simultaneously involved.

The effects of reaction are also illustrated *locally* in the condition of wounds. Local reaction takes the form chiefly of inflammation, and is carefully studied by the surgeon, who finds in it a ready means of estimating the severity of an injury; the vigour of the system generally, and of the affected part; or, it may be, the value of some particular kind of treatment.

Treatment.—Reaction may itself call for treatment when it is either imperfect or excessive. Stimulation is demanded in the former case—for instance, by warmth, alcohol, or ammonia. When reaction is excessive, nervous and circulatory sedatives are equally indicated.

J. Mitchell Bruce.

RECEPTACULUM CHYLI, Diseases of.—The receptaculum chyli is the dilated portion of the absorbent system forming the commencement of the thoracic duct, which receives the contents of the lacteal vessels, and of the lymphatics of the lower limbs and abdomen. It lies deep in the abdominal cavity, about the level of the first lumbar vertebra. The only morbid conditions which need be specially noticed in connexion with this structure are *dilatation* and *rupture*. The receptaculum chyli has been found in rare instances enormously dilated, and its walls thickened. It has also been known to burst as a result of this dilatation, with the escape of its contents into the peritoneal cavity, fatal peritonitis being thus set up. It would be quite impossible to diagnose or treat these conditions during life, and they have only been discovered on *post-mortem* examination.

Frederick T. Roberts.

RECOARO, in the Province of Vicenza, in Italy.—Chalybeate waters. *See* Mineral Waters.

RECRUDESCENCE (*re-*, again; and *crudesco*, I become fresh).—The increase or exacerbation of a disease or morbid process, after a temporary diminution; for example, of fever or inflammation.

RECTUM, Diseases of.—Synon.: Fr. *Maladies du Rectum*; Ger. *Krankheiten des Mastdarms*.

The diseases of the rectum may be conveniently discussed in the following order: (1) Congenital Imperfections; (2) Fistula in

Ano; (3) Cancer; (4) Polypus; (5) Prolapse; (6) Non-Malignant Stricture; and (7) Ulceration. Other diseases connected with the rectum will be found discussed under special headings. *See* ANUS, Diseases of; DEFÆCATION, Disorders of; HÆMORRHOIDS; and STOOLS, Characters of.

1. **Congenital Imperfections.**—Malformations of the rectum may be classed as follows: (1) Imperforate anus, without deficiency of the rectum. (2) Imperforate anus, the rectum being partially or wholly deficient. (3) Anus opening into a *cul-de-sac*, the rectum being partially or wholly deficient. (4) Imperforate anus in the male, the rectum being partially or wholly deficient, the bowel communicating with the urethra or neck of the bladder. (5) Imperforate anus in the female, the rectum being partially deficient, and communicating with the vagina. (6) Imperforate anus, the rectum being partially deficient, and opening externally in an abnormal situation by a narrow outlet. (7) Narrowing of the anus. These imperfections can be remedied either partially or completely by surgical operations.

2. **Fistula in Ano.**—DESCRIPTION.—The loose areolar tissue around the lower part of the rectum is occasionally the seat of abscess, which bursts externally near the anus (*see* PERIPROCTITIS). But instead of the part healing afterwards, like abscesses in other situations, the walls contract and become fistulous, and the patient is annoyed by a discharge from the opening. On introducing a probe it may pass through a small opening in the coats of the rectum into the bowel. The case is then called a *complete fistula.* When there is only one aperture, either mucous or cutaneous, the term *incomplete fistula* is used. The external orifice is usually near the anus, the internal between the two sphincters. The abscess before bursting may have burrowed to some distance, and the external orifice may be situated in the direction of the buttock or perinæum. Fistula in ano arises in several ways. It commonly originates in an abscess in the ischio-rectal fossa, the anatomical condition of the parts not favouring closure after the pus has escaped. An ulcer just within the external sphincter sometimes perforates the bowel, allowing the escape of fæculent matter into the areolar tissue, and thus leads to abscess. Ulceration induced by a pointed foreign body, as a fish-bone, may also induce a rectal abscess. Fistula is common in the late stages of rectal cancer. Fistula occurs also in phthisical subjects, owing to tuberculous mischief in or around the rectum. This tuberculosis may be primary or secondary, and in the discharge from such fistulæ the bacillus of tubercle has been found. The inner opening is sometimes found higher up the bowel, and there may be more than one, the sinuses being complicated.

An anal fistula is an annoying complaint. The patient is troubled with a discharge which stains the linen, and with the escape of flatus. Attacks of inflammation and suppuration are common, and the trouble produces often great mental depression, and much constitutional disturbance. Fistula is a disease of middle life, more common in men than in women.

TREATMENT.—The cure of fistula in ano is by a surgical operation.

3. **Cancer.**—Cancer of the rectum is common; appears with about equal frequency in males and females; and is an affection of middle life or old age. The form of cancer is that known as cylindrical epithelioma or adeno-carcinoma.

It corresponds with the squamous epithelioma of other parts, and the most conspicuous feature is the infiltration of the submucous and muscular coats with adenoid growth. Scirrhus cancer is not met with in the rectum. The growth may appear as a tuberous mass springing from one side of the rectum, and more or less occupying its lumen; or it may assume the aspect of a laminar deposit in the rectal walls; or may take the form of an annular growth. The deposit tends to narrow the bowel, and is disposed to early ulceration. The growth may invade and open the vagina, urethra, or bladder, and is in time attended with glandular enlargements. Malignant disease may attack any part of the bowel, but generally appears in the lower part, within three inches of the anus. It is liable also to affect, though less frequently, the point where the sigmoid flexure terminates.

SYMPTOMS.—The disease generally commences insidiously. Its early symptoms are often similar to those of simple stricture, and the real disease is usually not detected until a considerable change has taken place in the condition of the bowel. The patient is troubled with flatulency; has difficulty in passing his motions; and as the disease progresses, experiences pains about the sacrum, which gradually increase in severity, and dart down the limbs. The stools become relaxed and frequent; contain blood; and in passing cause a scalding pain. Often also there is a thin offensive serous discharge. The first symptom complained of may be an obstinate diarrhœa. Loss of retentive power may ensue, from destruction of the sphincter, or of the nerve supplying the muscle. As the disease advances the patient loses flesh, and exhibits the blanched, sallow look, anxious countenance, and emaciated appearance commonly observed in persons suffering from malignant disease. In consequence of communications established with the neighbouring passages, liquid fæces may escape from the urethra in the male and vagina in the female; and at length the patient becomes exhausted by this painful and distressing

malady. Complete obstruction may occur, and accelerate the fatal termination. There is great variety in the degree of suffering, and of constitutional derangement. The pains are in some instances excruciating, in others very slight. If the growth can be reached by the finger, it will be found to present a hard, nodular, uneven, and ulcerated surface, and to become soon fixed.

Treatment.—Little can be effected by remedies in this terrible disease, beyond palliation of the symptoms, and ease from pain. The general health may be supported by tonics. The motions must be kept soft by medicines or by injections, and pain must be alleviated by narcotics, such as morphine given in suppositories or by subcutaneous injections. Local applications of cocaine answer well in some cases. The diet must be carefully regulated so that as little *débris* as possible is left in the intestine, and the bowel should be frequently irrigated with some antiseptic injection. In cases of obstruction, as well as in cases of severe suffering, life may be greatly prolonged by colotomy. Excision of the diseased bowel has also been resorted to, but not with much success.

4. **Polypus.**—Polypus of the rectum may be conveniently considered under three headings: (1) *The soft polyp or adenoma.* (2) *The firm polyp or fibroma.* (3) *The villous polyp or papilloma.* They are all innocent growths.

Description.—(1) The *soft* polypus is a true adenoma, with a network of small vessels ramifying in it, and a peduncle which varies in length. The polypus is usually single, but several may exist. In children it usually makes its appearance at the anus after a stool, resembling a small strawberry, being soft in texture, granular on the surface, and of a red colour. It has a narrow pedicle, about the size of a crowquill, attached to the wall of the rectum, as a rule about two inches from the anus. It produces no suffering, but causes a slight bloody discharge, some tenesmus, and a sense of a foreign body in the bowel. It is the commonest form of polyp.

(2) The *hard* or fibrous polypus occurs in adults, is of a pear-shape, and has a peduncle more or less long and thick. It seldom bleeds, but occasions a slight mucous discharge; and when the peduncle is long, the growth protrudes at the anus after stool. It is uncommon; and is due to a fibrous growth in the submucous tissue.

(3) The villous polyp is a pure papilloma developed from the mucous membrane of the rectum. It is soft in structure, presents the usual appearance of a papilloma, may have a pedicle, but is usually sessile. It is rare, is met with in adults, and is innocent. It gives rise to considerable bleeding, and usually to a mucous discharge, and the symptoms of a foreign body in the bowel.

Treatment.—The treatment is usually very simple, and involves an operation of small magnitude.

5. **Prolapse.**—In relaxed states of the sphincter muscle and coats of the bowel, loose folds of mucous membrane are liable to protrude, and require replacement. This protrusion and exposure of thickened mucous membrane, with or without internal hæmorrhoids, has been described as partial prolapse of the rectum. In the true or complete prolapse there is much more than an eversion of the lining membrane of the bowel. The gut is inverted; there is a 'falling-down' and protrusion of the whole of the coats—a change analogous to intussusception, but differing from it in the circumstance that the involved intestine, instead of being sheathed or invaginated, is uncovered and projects externally. In the majority of instances the prolapse, even when extensive, concerns the mucous membrane only.

Ætiology.—Prolapse is observed generally between the ages of two and four, but may occur later in life. In infancy it may be produced by protracted diarrhœa or by worms. The straining efforts to pass water in stone in the bladder also give rise to this affection in young subjects. In adults the descent results chiefly from a weakened condition of the sphincter and levator ani muscles. It is more common in women than in men, arising in the former from the parts being weakened in child-bearing. It may follow also upon dysentery, upon conditions producing straining, and upon rectal polyp. Young subjects generally outgrow this complaint by the period of puberty; and common as is prolapse in early life, it is rare in young adults.

Description.—The length of bowel protruded varies from an inch to six inches or even more. When not of any great length, the protrusion forms a rounded swelling which overlaps the anus, at which part it is contracted into a neck. In its centre there is a circular opening communicating with the intestinal canal. An inversion of greater length forms an elongated pyriform tumour, the free extremity of which is tilted forwards or to one side. The protrusion may present the usual florid appearance of the mucous membrane; or a violet livid colour from congestion, consequent upon contraction of the sphincter. The mucous surface is often thickened and glandular, and sometimes ulcerated from friction against the thighs and clothes. Thickening of the coats of the bowel accounts for the difficulty in reducing the parts, and in keeping them reduced afterwards, a trouble so often experienced in the treatment of these cases in children, the bowel being too large to be conveniently lodged in its natural position, and, like a

oreign body, exciting the action of expulsion. An atonic or relaxed state of the sphincter muscle is shown by the facility with which one or two fingers can be passed through the anus even in young children.

Treatment.—In children irritability of the bowels and diarrhœa must be checked, and disordered secretions corrected by suitable remedies. In slight cases it will be sufficient to direct the nurse by steady compression to press the protrusion back within the sphincter. The relaxed state of the membrane may be treated with astringent injections of alum, or with a solution of tannic acid in glycerine, or with hamamelis. If the bowel slips down when the child moves about, rest must be insisted on. When the exposed surface is ulcerated, it may be painted with a solution of nitrate of silver, 20 grains to the ounce. The patient should be made to relieve the bowels in the recumbent posture. In adults, if no relief follows the removal of the apparent cause, the regulation of the bowels, rest, and the use of astringent applications, the complaint may be remedied by operation.

6. **Non-Malignant Stricture.**—Non-malignant stricture of the rectum is usually due to the development of cicatricial tissue, and has followed injuries, suppuration, dysentery, syphilis, and tubercular mischief. Mr. Cripps has shown that long-continued muscular spasm may play an essential part in the production of stricture.

Simple stricture is met with in adult life, is more common in women than in men, and is usually situated within three inches of the anus. The stricture may be *annular* or ring-like; or the obstruction may assume a *valvular* form; or a large part of the length of the bowel may be involved, producing a *tubular* stricture. The mucous coat above the stricture may be ulcerated. Often ulcerated apertures lead to fistulous passages, extending some distance, and opening externally near the anus or in the buttock, and, in women, in the vagina.

Symptoms.—The earliest symptom is habitual constipation, with difficult defæcation when the motions are solid. As the contraction increases, the constipation becomes more obstinate, and the stools are diminished in calibre, and are often voided in lumps. A brown slimy fluid escapes with the motions, and there is a burning sensation after stool, and flatulent distension of the colon. As the disease makes progress and ulceration ensues, the discharges become purulent and bloody, and the sufferings are much increased. There is sometimes so copious a discharge as to mislead the practitioner, the stricture being overlooked, and the case treated as one of protracted diarrhœa. The appetite may remain good, and the general health may be but little impaired; but in the course of time the derangement of the digestive functions, the irritation kept up by the disease, and the exhausting discharges, bring on symptoms akin to hectic. The appetite fails, the body emaciates, the abdomen becomes more distended, and the stricture directly or indirectly proves the cause of death. This is sometimes hastened by a lodgment of hardened fæces or some foreign body just above the stricture, so as to block up the passage, and occasion all the symptoms of intestinal obstruction. In patients with stricture small flattened excrescences are often observed at the margin of the anus. These cutaneous growths resemble collapsed external piles, except that they are redder in colour, and are kept moist by the escape of an irritating discharge from the bowel. Compared with cancer, the progress of the disease is very chronic, the edge of the stricture is hard and ridge-like, ulceration is absent or at least is not marked, induration is slight, there is less bleeding, and less fixity of the part.

A stricture in the lower part of the rectum can be easily detected by the finger. It must be borne in mind that the bowel is liable to be obstructed by disease of the neighbouring viscera—an enlarged or displaced uterus, fibrous tumours of this organ, an ovarian growth, pelvic hæmatocele, excessively hypertrophied prostate, or hydatid tumour between the bladder and rectum.

Treatment.—The main object in treatment is to dilate the contracted parts sufficiently for the free passage of the motions; and this is to be effected by mechanical means—by the frequent passage of bougies, or the occasional use of special dilating instruments. Means must also be adopted to relieve the irritability of the part, and to ensure the regular passage of soft evacuations. Cocaine, belladonna, or morphine suppositories at bedtime, properly selected aperients, careful dieting, and the daily washing out of the bowel, are the remedies required. In old inveterate strictures, wearing out the patient's strength, colotomy may be recommended.

7. **Ulceration.**—The chronic ulcers met with in the rectum are the following: The *tubercular*, the *syphilitic*, the *dysenteric*, those due to *injury* or *suppuration*, the *hæmorrhoidal*, which has the same pathological basis as the varicose ulcer of the leg, and the *follicular*, which involves the solitary follicles of the part. *Lupus* is also met with in the rectum, producing the destructive ulcer known by the French as *l'esthiomène*. It is merely an advanced form of the tubercular ulcer.

These ulcers have the physical characters of like ulcers met with elsewhere. The tubercular ulcer is very apt to perforate. The chief symptoms are a purulent discharge from the anus; motions loose and mixed, or coated with a slimy fluid and streaked with blood; soreness in defæcation;

and occasionally tenesmus. The characters, position, and extent of the ulceration can be ascertained by examination with the finger and with the speculum. The examination, to be satisfactory, must be conducted when the patient is anæsthetised.

Treatment.—The treatment depends on the nature and extent of the disease, and upon the constitutional condition of the patient. In severe cases the patient should be kept in the recumbent position, and the diet should be regulated. An exclusively fluid diet may be desirable in some cases. The bowels must be attended to. The local treatment consists of antiseptic or astringent injections or ointments. Weak solutions of nitrate of silver are of value, as are also injections of bismuth mixed with starch. Iodoform or other ointment may be applied by means of an ointment introducer.

T. B. Curling. Frederick Treves.

RECURRENT DISEASES. — Diseases which have a tendency to return after their actual or apparent cure or removal, either without any obvious cause, such as cancer or ague, or from some very slight cause, such as gout or rheumatism.

RECURRENT INSANITY. — *See* Insanity, Varieties of.

RECURRENT LARYNGEAL NERVE, Diseases of. — *See* Pneumogastric Nerve, Diseases of.

RED GUM.—*See* Strophulus.

REDUPLICATION.—A doubling. A term generally used in reference to the sounds of the heart. *See* Physical Examination.

REDUX (Lat., returned).—A term signifying the return of certain physical signs, after their temporary disappearance in the course of a disease; usually associated with crepitation in pneumonia, and with friction in pleurisy and pericarditis. Redux signs are, as a rule, significant of a favourable tendency in a disease. *See* Physical Examination.

REFLEX DISORDERS.—These constitute a very varied group of affections, most of which are individually considered in separate articles. But it will be useful here to say a few words concerning them as a group, in order that the mutual relations of many apparently discordant conditions may thus be set forth, from the point of view of their origin or pathogenesis.

Pathology.—The factors concerned in the production of a reflex disorder are in kind those which are needful for the production of a 'reflex action'—though in the former case such causes act for an inordinately long time, or else with an intensity which is altogether unusual. In each case we must have (*a*) afferent impressions resulting from the influence of a foreign body or a pathological state (such as inflammation or ulceration), acting as an irritant upon *afferent nerves*, either in some part of their course, or in their peripheric sites of distribution—whether such sites be situated upon the external surface of the body, or upon some part of one or other of the mucous surfaces within the body. Thus it happens that the determining cause may in some cases be associated with painful impressions, though in many other instances such impressions may be more or less completely absent. Occasionally mental emotions may take the place of peripheric impressions, as inciters of abnormal reflex phenomena.

The next essential factor (*b*) is that the afferent impressions (painful or non-painful) produced by the irritant or pathological state, should pass from the nerves, conveying them through a related *nerve-centre*, which, from one or other cause, chances to be in a state of exalted activity; and thence (*c*) be reflected along one or other set of *efferent nerves*, so as to produce effects of this or that order.

Varieties.—As efferent nerves are distributed to glands, and to muscles (both involuntary and voluntary), reflex phenomena may show themselves in one or other of two principal directions—that is, (1) by the modification of the quantity or quality of some *secretion*, or (2) by the production of spasmodic contractions in certain *muscles*, either (*a*) of the involuntary or (*b*) of the voluntary type. In these ways, multitudinous and varied effects are apt to be produced on different occasions, as may be gathered from the following brief illustrations.

1. *Modified secretions.*—The morbid effects belonging to this class of reflex disorders show themselves, for the most part, by a diminution rather than by an increase in the amount of the secretion of the gland whose functions are affected, as when irritation of some of the abdominal nerves leads to a suppression of the renal secretion, by setting up some form or mode of inhibitory influence. The action of cold upon the external surface of the body in producing an increased secretion of urine, is probably brought about by an augmented determination of blood to the kidneys, and not as a simple result of reflex action. The mental conditions of anxiety, fear, or terror do, however, often lead to an increased secretion of urine; and the increased secretion in these cases may be brought about by simpler and more purely reflex influences. Again, precisely the same mental states may lead to an arrest of the salivary secretion, as well as to such an increase of the intestinal secretions as to produce loose evacuations or actual diarrhœa. Other instances might be included under this head, but they are all of them phenomena the precise mechanism of which is comparatively obscure. Still in each case the mode

of production of the phenomena would seem to conform to the type indicated.

2. *Muscular spasms.*—The morbid effects belonging to this second class of reflex disorders are also variable in their occurrence, and more or less uncertain as regards their precise mechanism. Referring first of all (*a*) to the reflex spasms induced in involuntary muscles, it may be said that reflex spasms set up by some contiguous source of irritation are met with not infrequently in the urethra and neck of the bladder, in the sphincter of the vagina, or at the commencement of the œsophagus. They may also occur in the bronchi (as in asthma), or in portions of the intestinal canal (colic); likewise in the ureters or in the gall-ducts, during the passage of calculi along either of them.

As an instance of a spasm engendered in involuntary muscular fibres, under the influence of a mental emotion or state, rather than a peripheric irritation, one may cite the sudden contraction of the uterus in certain cases of abortion induced by fright, anger, or other powerful mental emotion. Again, acts of vomiting are produced occasionally by certain sights or odours.

On the other hand, tonic spasms of a reflex character chiefly occur in (*b*) the voluntary muscles (especially in children or in females of a nervous temperament), in the form of contractions of some of the muscles of the extremities, though at other times the muscles of the jaw or some of the muscles of the neck may be the parts involved. *See* SPASM.

Of infinitely more importance, however, are the multitudinous cases in which some sources of irritation, either within or on the surface of the body, occasion, in various more or less obscure ways, through the intervention of the great encephalic centres, convulsions or fits of one or other variety (*see* CONVULSIONS; and EPILEPSY). Here we have, as a result of the peripheric irritation, a whole series of spasms, partly tonic and partly clonic in character. It is worthy of note, too, that an irritant at the surface of the brain, in certain regions, is just as potential as an irritant acting upon the mucous membrane of the intestine.

But another class of reflex muscular spasms still remains, to which an immense amount of importance is attached by some pathologists, namely, those which are brought about through the agency of vaso-motor nerves acting upon the contractile walls of blood-vessels. It is well known that under the influence of direct irritation, vaso-motor nerves may cause small arteries and arterioles to contract to an extreme degree, and that this condition is apt to be followed by one of extreme dilatation of these same vessels. It is known also that under the influence of emotions the calibre of the vessels in certain parts of the body is apt to vary greatly. Of this we have examples in the temporary pallor of the countenance produced by fright, and in the suffusion of the face and neck, from unnatural fulness of vessels of these parts, in the act of blushing. On the other hand, it has been assumed that, as a result of some abiding irritation in the intestine, in the bladder, or in other parts, reflex contractions of the arterioles in certain regions of the spinal cord (also of an abiding character) may be brought about, so as more or less completely to annul the functions of this particular portion of the cord, and thereby to lead to paralysis of the lower extremities—that is, to paralysis of the limbs chiefly in relation with the region of the cord affected. This is the generally assumed mode of production of a so-called 'reflex paralysis.' Others, however, imagine that, in certain cases at least, such a paralysis may be brought about differently—not by the reflex action producing a spasm of vessels in a part of the spinal cord, but by a spasm of the vessels supplying the great nerves and muscles of the limbs affected. The anæmia, thus supposed to be induced in either case, is regarded as the cause of an ensuing paralytic condition. But the question as to the probability of the existence of 'reflex paralysis' need not be here discussed, since the arguments for or against the existence of such a paralysis which are applicable to one form of it are applicable also to another, and these are set forth in the article SPINAL CORD, Special Diseases of: 28. Reflex Paraplegia.

It does not seem to be imagined by anyone that a local irritation is capable of engendering a condition of paralysis by any direct inhibitory process. The intervention of altered conditions of vaso-motor nerves and of altered states of vessels seems to be postulated by all. Yet some such direct influence may, perhaps, be more possible in those related cases in which the starting-point or primary cause of paralysis is a mental state rather than a peripheric irritation—that is, in the ætiologically obscure cases described by Dr. Russell Reynolds as *Paralysis dependent upon Idea.* *See* SPINAL CORD, Special Diseases of.

It is right here, also, to mention a class of phenomena which have some analogies to reflex disorders, that is, the numerous cases in which, as a consequence of irritation in one or other region, *pain* is felt in some more or less distant part of the body, as when a stone pressing upon the neck of the bladder causes severe pain at the meatus urinarius, or when disease of the stomach or of the liver causes a pain which is felt in the scapular region.

H. CHARLTON BASTIAN.

REFLEXES, Spinal. — *See* SPINAL CORD, Diseases of.

REFRACTION, Disorders of.—*See* VISION, Disorders of.

REFRIGERANTS (*refrigero*, I cool).—DEFINITION.—Remedial agents which lower the body-heat, either in health or in disease; or which allay thirst, and impart a feeling of coolness.

ENUMERATION.—The chief refrigerants are: The whole class of Febrifuges; Water; Ice; Effervescing drinks; Acidulated drinks; and the juices of Fruits.

ACTION.—As the name implies, anything may be ranked as a refrigerant which lowers the body-temperature, and we may here consider in how far the drugs described under FEBRIFUGES have the property of cooling down the healthy organism. Quinine and alcohol have but a slight and transient lowering effect, and salicylic acid has none at all; and this is readily explained, if we believe that their antipyretic properties in fever depend on their destructive influence over the protoplasm or products of septic ferments.

Refrigerants, however, are popularly held to be those drugs which relieve the thirst of the fever-stricken patient, by moistening his dry lips and cooling his parched tongue. Ice or iced drinks manifestly fulfil these indications; and acids well diluted, which are often the most grateful of all, act very efficiently by directly stimulating the salivary secretion.

R. FARQUHARSON.

REGIMEN (*rego*, I govern).—This word is not uncommonly used as synonymous with hygienic management. In a more restricted sense it is applied to the regulation of diet, both in health and disease. *See* DIET; and PERSONAL HEALTH.

REGURGITATION (*re-*, again; and *gurgito*, I swallow).—This word is technically applied to the reversal of the natural direction in which the current or contents flow through a tube or cavity of the body. Thus the food may regurgitate from the stomach into the œsophagus and mouth; the bile from the duodenum into the stomach; and blood from the aorta or pulmonary artery into the ventricles, from the ventricles into the auricles, or from the heart into the veins, when the respective valves are incompetent. *See* HEART, VALVES AND ORIFICES OF, Diseases of; and RUMINATION.

REHME (Oeynhausen), in Germany.—Gaseous thermal salt waters. *See* MINERAL WATERS.

REICHENHALL, in the Bavarian Alps.—Common salt waters. *See* MINERAL WATERS.

REINERZ, in German Silesia.—Chalybeate waters. *See* MINERAL WATERS.

RELAPSE (*re-*, back; and *lapsus*, slipping).—The return of a disease, which has apparently ceased, during or immediately after convalescence; or of a particular symptom in the course of a disease. Relapses are well exemplified in typhoid fever and acute rheumatism.

RELAPSING FEVER.—SYNON.: Famine Fever (Irish writers); Fr. *Fièvre à Rechute*; Ger. *Hungerpest*. Also many other names, according to the localities where it has prevailed as an epidemic.

DEFINITION.—A continued contagious fever; characterised by absence of eruption, and a tendency to relapse at intervals of from five to seven days, and for an indefinite number of times, accompanied during the paroxysms by a spirillum, and generally occurring as an epidemic.

All medical writers, from the earliest times, recognise the existence of a relapsing form of continued fever; but this disease had until recent years been included under the general term 'Continued fever.' Even in the great Irish famine fever of 1847, many of the Dublin physicians did not sufficiently distinguish between typhus and relapsing fever; and we find a statement often made that the fever relapsed into typhus, or that typhus relapsed into a form without spots. There is no doubt that typhus and relapsing fever co-existed at the time of the Irish famine, as they have invariably done at all times and places in seasons of great scarcity.

GEOGRAPHICAL DISTRIBUTION.—Northern Europe seems to be the favourite habitat of relapsing fever. It has been met with in America, but not as an epidemic, having been imported from Europe, and not showing a tendency to spread. An epidemic outbreak occurred at Peshawur in the Punjab, and also in Egypt. Epidemics have been more common in the British Isles than elsewhere. The most extensive epidemics have arisen in Ireland in times of famine, and extended thence to England and Scotland. An epidemic was confined to Scotland in 1843, and another to London in 1868.

ÆTIOLOGY.—*Predisposing causes.*—Males suffer more from relapsing fever than females, in the proportion of about 1·5 to 1. The disease is most common between the ages of fifteen and twenty-five. Season seems to have little effect, but it appears to be more prevalent in winter than at other seasons, because the other predisposing causes are more intense at that time of the year. All the causes which predispose to contagious zymotics favour more or less the prevalence of relapsing fever. The most powerful, however, are scarcity of food, overcrowding, and want of cleanliness.

Exciting causes.—Relapsing fever is contagious, and has always been found to spread in proportion to the facilities for communica-

tion. It has been transported from long distances by affected persons; it attacks attendants on the sick, and persons not predisposed when they are exposed to its contagion; and may be communicated by fomites. It seems to act through but a short distance. The period of incubation is uncertain, sometimes being apparently almost absent, at other times stated to extend to fourteen or twenty-one days.

Famine and its consequences, or famine alone, is a cause for the origin of relapsing fever *de novo*. Some doubt the truth of this statement, but it is usually received by writers upon the disease. The evidence in favour of famine as a cause rests upon the 'fact that after it has been absent for many years, it breaks out on each occasion under precisely similar circumstances' (Murchison). The circumstances preceding an outbreak are invariably failure of crops, and consequent famine. Relapsing fever, although usually prevailing among overcrowded persons in large towns, must not be considered to depend upon this condition, except so far as overcrowding favours the spread of contagion. The overcrowding in towns during an epidemic results from the same cause as that producing the fever; namely, the scarcity of food in the country, which drives people into the towns.

Anatomical Characters.—These are not marked, except where complications have caused death. The liver and spleen are both found enlarged in all cases, especially the latter organ. The digestive organs exhibit nothing particular, except in those cases where there has been long deprivation of food, or where dysentery or diarrhœa has accompanied or preceded the disease. A spirillum—*spirillum* or *spirochæte Obermeieri*—is found in the blood of patients suffering from relapsing fever. This micro-organism decreases as the paroxysms subside, and is absent during the intermissions. The spirillum was discovered by Obermeier of Berlin in 1872, and the discovery was further confirmed by Engel in 1873. A full account of this organism is given under a special heading. *See* Micro-organisms.

Symptoms.—The invasion of the disease is usually marked by rigors, frequently of a trivial character, amounting only to slight chilliness. This is followed by debility and giddiness; extreme weakness is not so marked as in the early stages of other forms of continued fever. There is headache, followed after a few hours by hot skin; the temperature rises to about 105° F., or sometimes, it is stated, as high as 108°; the pulse rises to from 110 to 130, occasionally counting 140 at an early stage of the disease. The tongue is covered with a moist creamy fur, which in severe cases becomes brown and dry in the centre, and in the worst forms becomes black all over. There is great thirst, as in all febrile diseases; loss of appetite; some abdominal tenderness, especially in the epigastric region; occasionally nausea, and more rarely vomiting; the bowels are usually confined, but in some cases diarrhœa prevails. In such cases the diarrhœa is of a dysenteric character, and is probably due to the dysenteric tendency which usually prevails in time of famine, when relapsing fever is prevalent. The skin generally presents a jaundiced hue; and careful examination will detect more or less enlargement of the liver and spleen. There is great muscular and articular pain. The pain in the back is frequently of the most intense character. Headache is more complained of than in the other forms of fever. There is sometimes, but not as a rule, delirium towards the end of the first week.

In from five to seven days from the invasion of the disease, the symptoms suddenly subside, and the patient quickly becomes convalescent, being for the time apparently well. This convalescence is frequently accompanied or preceded by a critical evacuation from the bowels, kidneys, or uterus, or by profuse diaphoresis. It may be permanent, but more commonly the patient remains well for a few days or a week, and then suddenly relapses, and passes through all the symptoms previously detailed. There may be a second or a third relapse, and even a fourth has been recorded. At no time during the progress of the disease is any specific eruption developed, although on the second or third day a reddish mottled rash has been met with, which, however, is irregular in its appearance, development, and duration, and usually terminates in desquamation. Purpuric spots have been sometimes, and sudamina very frequently, met with.

Complications. — Pulmonary complications are not so common in relapsing fever as in typhus or enteric fever. Bronchitis, pneumonia, and laryngitis may occur, especially bronchitis, but these complications are not severe. Cardiac, arterial, or venous affections are rare, with the exception of hæmorrhages, which must be considered as being connected with the purpuric tendency which usually prevails in times of scarcity. Nervous complications are more rare than in any other form of adynamic fever. Dysentery and diarrhœa in some epidemics have proved to be most serious complications, and are of frequent occurrence whenever relapsing fever prevails. Abscess and other suppurative forms of inflammation are not common. In pregnant females attacked by this fever abortion usually occurs at an early stage of pregnancy; and premature labour, with death of the fœtus, and considerable danger to the mother, in the later stages of pregnancy. Death of the mother has sometimes happened from *post-partum* hæmorrhage.

Diagnosis.—Relapsing fever is most likely

to be mistaken for other forms of continued fever, and may be confounded with the eruptive fevers in their earlier stages, especially small-pox. It differs from typhus in having a higher temperature and quicker pulse at the outset; in the absence of the specific eruption, of the extremely heavy aspect of the patient, and of the delirium of typhus; in the presence of extreme pains in the back, vomiting, and jaundiced tinge of the skin; and finally in the sudden cessation of symptoms, and the tendency to relapse.

Relapsing fever differs from enteric fever in the suddenness of its onset, enteric fever having a slow invasion; the want of the marked and extensive daily variations in temperature; the absence of the characteristic abdominal symptoms and eruption; and the absence of the localised iliac tenderness and the peculiar diarrhœa of enteric fever. The tongue also serves to distinguish relapsing from enteric fever; in the latter having a well-marked red tip and edges, in the former a light covering fur. Relapsing fever at its commencement has been confounded with small-pox, on account of the extreme pain in the back and marked vomiting which accompany both these diseases, but the appearance of the specific eruption will soon decide the question.

Prognosis, Duration, Terminations, and Mortality. — The prognosis of relapsing fever is usually favourable, the mortality being low, from 1·2 to 2 per cent. in London, up to 4 and 4·5 per cent. in other places; the average rate being about 4 per cent. The chief causes influencing the rate of mortality seem to be the prior state of the patient, and the duration of the disease before medical relief is applied for. Purpuric symptoms, severe dysentery or diarrhœa, serious hæmorrhages, or extensive chest-complications, always indicate a grave prognosis.

Treatment.—The treatment of the disease must be preventive and curative. The chief promoting causes of the disease being famine and contagion, the means for prophylaxis are obvious. The active treatment must chiefly be directed towards the relief of symptoms, and sustaining the strength of the patient. The use of quinine and mineral acids in the earlier stages, and a plentiful supply of light and nourishing food in the later, will be found sufficient. A considerable amount of the success of treatment will depend upon the dieting of the patient. It must be kept in mind that most of these patients have been in a state of starvation. It will be necessary, therefore, to carefully and gradually increase the supply of food. The food at first must be of a most digestible and fluid kind, which may gradually be altered to a diet of a more solid and general character. Dysentery has not infrequently been caused by the sudden feeding of patients suffering from relapsing fever in its early stages. Milk, light starchy puddings made with milk, thin custards, and finally chicken, chops, and general diet will be found the best course in this disease. Stimulants may be occasionally requisite, but are seldom necessary in any quantity, or for a length of time.

T. W. Grimshaw.

RELAXATION, **RELAXED** (*re-*, again; and *laxo*, I loose).—These words signify a condition of looseness, and are used somewhat vaguely in a variety of associations. Thus we speak of *general relaxation*, to express a want of muscular tone or vigour. *Local relaxation* refers to a condition of abnormal looseness of a part, as of a joint, muscles, the uvula, or the throat, which are then said to be *relaxed*. Another signification of the term 'relaxation' is that of looseness of the bowels, as in diarrhœa.

REMEDY (*remedium*, a cure). — A remedy properly signifies a therapeutic agent which possesses a recognised influence in preventing, relieving, or removing a particular morbid condition. Thus vaccination is a remedy for small-pox; quinine for ague; mercury and iodide of potassium for syphilis; and opium for pain. *See* Disease, Treatment of.

REMISSION, **REMITTENT** (*re-*, again; and *mitto*, I send).—A disease is said to be remittent when it is characterised by periodical diminutions of symptoms, followed by exacerbations, as in remittent fever and neuralgia. The period during which the symptoms are in abeyance is called a *remission*. *See* Remittent Fever.

REMITTENT FEVER. — Synon.: Bilious Remittent; Fr. *Fièvre Rémittente*; Ger. *Bösartiges endemisches Fieber*.

Definition.—A paroxysmal fever of malarial origin, in which the paroxysms do not intermit, but only, as the name implies, remit.

General Observations.—Remittent fever is the most severe of the class to which it belongs; it is a more acute affection than intermittent fever, more severe in its symptoms, more rapid in its course, and the direct mortality is ten times greater than in any other form of malarial fever. It is commonly known in India as *jungle fever*, because it is in jungles there at certain seasons of the year that it is most frequently contracted. It often obtains local names derived from places notorious for producing it, a practice productive only of confusion and misapprehension. It is sometimes said to hold a middle place between intermittent and continued fever; the more nearly it resembles the latter, the more dangerous it is.

In other words, the less distinct the periods of remission, and the longer the stage of exacerbation, with its high temperature, and other disturbances of the system which characterise that stage, the greater is the risk of such blood- and organic changes as are incompatible with life.

Remittent fever is usually seen in its gravest forms in hot climates, but has often been very fatal in malarial regions in temperate climates, as in Walcheren. This, in unhealthy countries, is often the first form of fever that attacks new-comers, but such are seldom exposed to second attacks; in other words, there is in this type less tendency to a recurrence of the disease than in the intermitting form. It may be that the extremely energetic character of the symptoms in the remittent type is more effectual in destroying, altering, or 'eliminating' the poison, than the milder intermittent attack. In 1865, out of 3,199 cases of remittent fever admitted into the military hospitals of Algeria, only 359 had second attacks; while out of 15,080 cases of intermittent fevers, 4,295 were re-admitted with the same type of fever (*Statistique Médicale de l'Armée*, 1865). The medical officers of our army in Spain observed that their men, on entering a malarial locality, generally suffered severely from the remittent form, while the inhabitants of the country were only affected by the intermittent type. Survivors, however, who remain in the locality, become, like the inhabitants, only liable to the milder type of the disease.

Ætiology. — Remittent fever is found whenever its specific cause is generated in sufficient concentration to excite it (*see* Intermittent Fever; and Malaria). It prevails in the malarial parts of the Old and New World. Our armies have suffered from it both in temperate and hot climates; in the East and West Indies, and, with extreme malignity, on the West Coast of Africa. It is a common disease in the malarious parts of Italy; and the French army has suffered much from it in Algeria. It is seen in the deltas of great rivers, in the *terais* of India, in jungles, and in other districts in the same country long left uncultivated.

Anatomical Characters. — The morbid anatomy of remittent fever is the same as in intermittent fever; the difference is only in degree. Congestion of the mucous coat of the stomach and duodenum, with softening, is more marked than in other types of malarial fever, as well as enlargement of Brünner's glands. The pigmentary degeneration of the spleen and liver is more intense, often extending also to the brain and spinal cord, giving them a bronzed appearance. At a recent *post-mortem* examination the micro-organisms characteristic of malaria will be found in abundance in the blood generally; also especially in the spleen, and in the vessels of the brain and liver. In pernicious types the vessels are actually obstructed by these organisms.

Symptoms. — *Premonitory.* — These are much the same as in a severe intermittent.

Cold Stage.—The term is hardly applicable in this fever; the patient is sensible only of a slight sensation of chilliness, which very rarely passes into rigors. Nevertheless, the thermometer indicates a temperature above the normal, and in the hot stage this quickly rises to 106°, 107°, and sometimes to 110° F.

Hot Stage.—As this develops, the whole system is profoundly disturbed. There is the high temperature already indicated, which, when fully developed in the worst cases, approaches within three degrees of that in which the albuminoid constituents of the muscular tissue begin to coagulate. This grave symptom is seen in its utmost intensity in those who have exposed themselves, perhaps after indulging in alcoholic liquor, to a powerful sun, without reasonable precautions. With this there is necessarily pungent heat of skin; an intensely flushed face; severe headache; pain in the back and limbs; quick respiration; a pulse of 120 or more; a foul, dry, and bile-tinted tongue; a sense of oppression at the epigastrium, with fulness and tension in that region; and violent vomiting, which brings no relief to the gastric oppression.

This vomiting is one of the most distressing symptoms; the quantity of fluid vomited far exceeds what has been taken by the patient; at first it is colourless, then bilious, and sometimes bloody. In pernicious cases it closely resembles the 'black vomit' of specific yellow fever. With the above symptoms there is an anxious countenance, and much restlessness. In this condition the patient remains from six to twelve hours.[1] Then the more urgent symptoms abate; the temperature falls two, three, or more degrees; the skin becomes slightly moist, far short of the profuse sweating in an intermittent fever; headache sensibly diminishes; and the nausea, vomiting, and epigastric tension either cease or sensibly abate. This is the *remission*, always anxiously looked for, not only as a relief to the patient, but as a precious time for treatment. In bad cases, when the other symptoms remit so little as to escape the notice of all but an experienced observer, the thermometer will indicate at least an attempt at a remission. This lasts from two to twelve hours; the longer it is, the more favourable is the prognosis. A feeling of chilliness then returns, quickly followed by the hot stage, with all its distressing symptoms. This is the *exacerbation* of systematic authors, which in its turn gives way to the remission.

[1] The description in the text applies to the disease in its most acute form.

A morning remission in this fever is so invariable as to be a point of diagnostic value, and it is an old rule in military practice so to time the morning visit as to ensure seeing the patient while it lasts. The exacerbation usually returns about noon, and in severe cases lasts till midnight. Sometimes two exacerbations occur, one at noon, the other at midnight, with a slight evening, and more distinct morning, remission.

The *skin* sometimes assumes a yellow tint, and if there be with this anything resembling black vomit, a false diagnosis of yellow fever may be made. The term 'yellow remittent' is correctly enough applied to such cases, but the resemblance between these and cases of specific yellow fever is only superficial.

Hiccough is a troublesome symptom, and if it appears late in the disease, and continues during the remission, is not a favourable one.

The *bowels* are usually constipated, but in pernicious cases the motions sometimes become very loose, bloody, and offensive, a condition of evil omen.

Jaundice is rare, although, as already said, the skin has often a yellowish tinge, more dependent on blood-changes than from an icteric cause.

Hepatitis.—The only cases of suppurative inflammation of the liver, occurring in the course of remittent fever, that have come under the writer's observation, were brought to Netley from the Gold Coast, where this serious complication appears common.

Delirium.—Except in men who have lived imprudently, and have indulged freely in alcohol, active delirium is rare. In all malarial fevers, the symptoms and lesions in remittents point more to implication of the abdominal organs than of the nerve-centres.

The *urine* is acid, scanty, and high-coloured, rarely albuminous—so rarely, that its absence is a point of diagnosis between malarial remittent and specific yellow fever. During the hot stage the secretion of urea is greatly increased, but lessened when convalescence sets in. In two very severe cases treated by the writer in India, there was profuse secretion of bloody urine throughout, which lasted until convalescence set in.

The *adynamic form* of remittent fever is one of great gravity. It is becoming every day more apparent that in bygone years—and perhaps even now in India—cases of enteric fever have been, and are, mistaken for malarial remittent. The diagnosis is not so easy as it may appear to those who are familiar with enteric fever pure and simple, as seen in temperate climates. There are cases of a mixed nature, in which a thread of malaria, so to speak, runs through the symptoms and obscures them. The term 'typho-malarial' has come into use in India to distinguish this class of cases, which are as difficult to treat successfully as to diagnose clearly. French and Italian writers would apply their favourite term 'pernicious' to such cases, which are characterised from an early stage by great prostration; brief and uncertain remissions; a quick and compressible pulse; a black and dry tongue, the teeth being covered with sordes; rapid respiration; epigastric tension and oppression; the bowels being loose, and the motions bloody, with a disposition to hæmorrhage from the mucous surfaces generally. Such cases are often fatal, and *post-mortem* examination, in addition to the common lesions of malarial fever, reveals ulceration of Peyer's patches.

Duration.—The duration of a remittent fever is from five to fourteen days; but, as in all miasmatic fevers, it is much affected by the action of remedies. In the worst forms death is rare before the eighth day.

Diagnosis. — 1. From *specific yellow fever.* — Remittent is paroxysmal; yellow fever is continued. Remittent has a morning remission; yellow fever has not Hæmorrhage from any source is exceptional in remittent; in yellow fever it proceeds from mouth, nose, eyes, ears, bowels, and even the urinary passages. Even in the worst remittents albuminous urine is rare; it is the rule in yellow fever. Over remittent fever the power of quinine is beyond question; the drug is powerless in yellow fever. Death in the worst remittents is rarely seen before the eighth day; in specific yellow fever it is common on the third day. The mortality rate in yellow fever is often 40 per cent. of those affected; that of remittent does not in ordinary circumstances exceed 4 or 5 per cent., and is often less. Yellow fever is portable and contagious; remittent is neither. Yellow fever has a special habitat of its own, and can only exist as an endemic disease in countries where the mean temperature does not fall below 72° F. Lastly, specific yellow fever has never established a footing on the shores of India, where malarial remittent is an endemic disease.

2. *Enteric fever*, pure and simple, ought not to be easily confounded with remittent. It is marked off by the difference in the thermometric curve: in enteric fever, the rise of temperature is slow; in remittents it attains its maximum in a few hours. There is also the characteristic eruption (not, however, invariably present in enteric fever in India), the iliac gurgling, and the peculiar stools of typhoid, all absent in remittent. As mentioned above, the diagnosis is not so easy when the peculiar symptoms of malarial mask or obscure those of enteric fever. Still, due observation of the peculiar combination of symptoms will enable careful practitioners to make a good practical diagnosis, and to regulate their treatment accordingly. It may seem unscientific to speak of two specific diseases existing together, and as it were